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SCIENTIFIC AMERICAN

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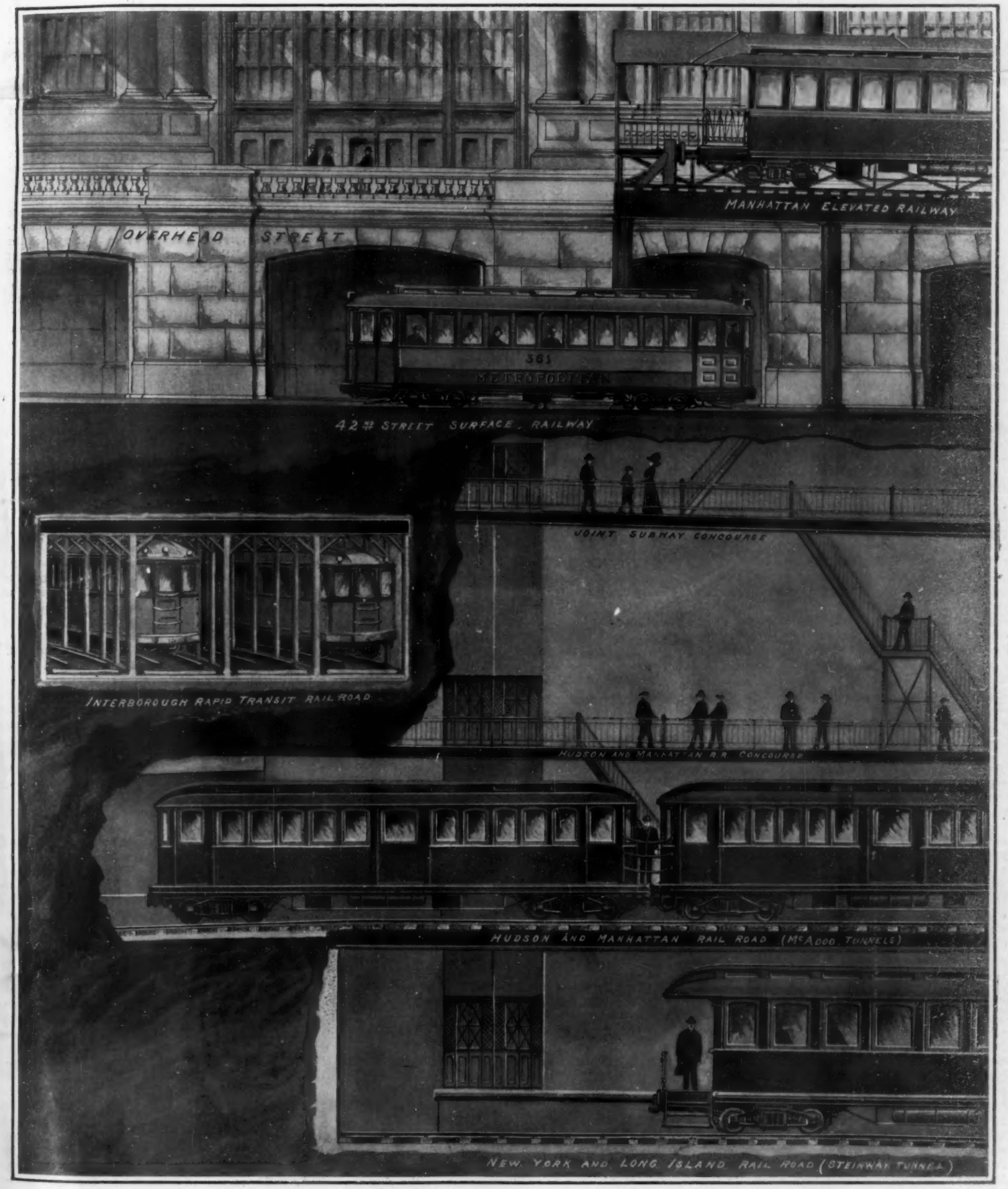
A POPULAR ILLUSTRATED WEEKLY OF THE WORLD'S PROGRESS

Vol. CIII.—No. 21. ESTABLISHED 1845. NEW YORK, NOVEMBER 19, 1910. 10 CENTS A COPY. $3.00 A YEAR.



This sectional view is taken on Forty-second Street facing the new terminal station of the New York Central. It shows five distinct superimposed lines of railway. At street level is seen the lower portion of the façade of the new Grand Central station with the Manhattan elevated and the Forty-second Street surface lines. Below are the Interborough, the McAdoo, and the Steinway tunnels.

A GREAT SUBTERRANEAN RAILWAY JUNCTION.—[See page 398.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

MUNN & CO., Inc., - Editors and Proprietors

Published Weekly at
No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*
361 Broadway, New York.
FREDERICK CONVERSE BEACH, *Secy and Treas*
361 Broadway, New York.

TERMS TO SUBSCRIBERS.

Subscription one year $3.00
Postage prepaid in United States and possessions Mexico, Cuba and Panama.
Postage to Foreign countries ..... $1.50 per year extra.
Canadian postage ..... .75 per year extra.

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845) ..... $3.00 a year
Scientific American Supplement (established 1876) ..... 5.00 "
American Homes and Gardens ..... 3.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.
MUNN & CO., Inc., 361 Broadway, New York.

NEW YORK, SATURDAY, NOVEMBER 19th, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

NAVAL REORGANIZATION AND THE COMING CONGRESS.

TO those of our readers who follow the course of naval affairs with intelligent attention, the next few months will prove of extraordinary interest; for the convening of Congress early in December will witness the end of the year's trial of Secretary Meyer's scheme of navy yard reorganization, reluctantly granted by the Naval Committees of the two Houses of Congress. It is therefore timely and appropriate to call attention, just now, to the salient features of the naval situation.

It is not necessary to review the history of the controversy unfortunately precipitated by the Secretary's scheme of reform—a controversy which is intimately related to the ancient feud between the Line and Staff, of which it is the latest expression. It is sufficient to say that Mr. Secretary Newberry, after spending some years in acquainting himself with the qualifications of the various classes of officers in the navy, selected Staff officers of certain corps as his principal instruments in carrying on the work of consolidating the navy's industrial establishments, he being of the opinion, not unreasonably, that officers who have specialized in industrial work, are better fitted to supervise it than sea-going officers whose acquaintance with industrial establishments is a mere incident in the intervals of their military duty.

Mr. Meyer, upon taking office, and after a necessarily brief association with the navy, radically changed the policy of the department—so much so, that under the regulations established by him, the Line officers are not only supreme in the exercise of their military functions, but are supreme also in all the varied branches of that industrial or manufacturing work, with much of which they, by the very exigencies of the case, have but a fragmentary knowledge—a knowledge which does not and cannot compare with that of the highly specialized staff officers whom they have displaced in managerial control.

Now we hold no brief for the Staff Corps in this matter, and we credit Mr. Meyer with the utmost sincerity of intention, and the sole desire to promote the best interests of the navy. But we cannot refrain from the comment that had the Secretary been absolutely under the control of the coterie of Line officers with which he has surrounded himself, he could not have arranged to hand the Staff Corps over to their tender mercies more completely.

It is interesting to note, in this connection, that the very officers selected by Mr. Newberry as most competent in industrial affairs, were not even considered worthy of being consulted by Mr. Meyer on this important topic; the boards which determined the present industrial organization containing not a single representative from the Staff—a most amazing omission.

We cannot but regard it as fortunate that the consent of Congress was, and is still, necessary for the complete establishment of Mr. Meyer's scheme; and it is a fact that such assent was not forthcoming at the last session of Congress, as Mr. Meyer received practically no legislative support. It is true that the Bureau of Equipment was tentatively abolished on the Secretary's recommendation, but this project had been in the air for some time. The only other legislation enacted bearing on this subject was distinctly antagonistic to the Secretary's idea of a paramount Line. We refer to the provision enabling Line officers to be detailed for duty under Staff officers in industrial work, a law which ended forever the absurd tradition that a Line officer must command wherever present.

It is therefore into an unfriendly atmosphere that the Secretary must carry that part of his forthcoming annual report, which deals with the results of this year's trial of his scheme of reorganization. We shall watch with keen interest the tenor of his statement and the warmth of its reception. We presume that the report will be generally favorable; for so far as we can understand the situation, Mr. Meyer has so completely put himself into the hands of the Line, that there is not a single remaining channel through which an unfavorable report could reach him. The Line are the secretary's aides; the Line do all the administrative work and the larger part of the industrial work; the Line inspect the work; and the Line report on the results and receive the reports.

In a word, the Line stand squarely across all channels of official communication and criticism, through which errors or inefficiency might reach the eye of the Secretary. Without wishing to cast the slightest suspicion upon the candor of the officers who thus intervene between the actual working results of the year's trial of the Secretary's scheme of reorganization and the Secretary himself, we would suggest to him that before writing his report he request his aides to furnish him with the original reports of work done under the supervision of Line officers who have superseded the Staff officers in control.

The reception afforded the Secretary's forthcoming report by Congress, however, is another matter entirely. If we have interpreted the record of his hearings of last year correctly, it appears that Congress has a serious intention of getting to the bottom facts of the subject at the coming session. Congress, as well as Mr. Newberry, has had experience, and appears to favor the management of industrial work, particularly at the navy yards, by Staff specialists; and we do not believe that an *ex parte* report, drawn up under the conditions referred to, will be sufficient to overcome their conviction. Furthermore, we do not believe that the forcing out of office of the late Chief Constructor and the Paymaster-General, as the result of their frank, fearless, and perfectly proper criticism of the proposed reorganization, will assist in recommending the scheme to the approval of Congress.

It is to be hoped that out of the present turmoil a scheme will be evolved which, while retaining to the Line their necessary supremacy in military affairs, will leave to the Staff the equally necessary control of the industrial (the construction and manufacturing) branches of naval work. Above all, it is to be hoped that the final arrangements will be such as to assure to the Staff that public appreciation, which forms the major part of the reward of successful technical service in the navy.

THE AEROPLANE FOR COMMERCIAL USE.

THE transportation of several hundred yards of silk from Dayton to Columbus, O.—a distance of 62 miles—in 57 minutes by a Wright biplane on the 7th, and the projected carrying of a bag of mail from a steamer 50 miles out at sea back to New York by a Curtiss biplane, mark the opening of the commercial era of the aeroplane in America.

It is indeed fitting that the land in which the new science and art of mechanical flight was born and had its early development, should be the first to utilize this latest means of rapid transport—the aeroplane—for peaceful and commercial purposes such as the carrying of mail and express matter. Especially is this the case when it is remembered that our government was the first to conduct experiments in mechanical flight and to purchase a military aeroplane.

The entrance of the heavier-than-air machine into the commercial field at this time, when the country is threatened with a strike of express employees that has resulted in a greatly augmented demand for a parcels post, will, if constant demonstrations of its utility be made, no doubt result in as rapid an adoption of the aeroplane for commercial use as its development has been rapid in comparison with that of the automobile. Only now, after an entire decade, are the horse-drawn mail vans of Chicago to be replaced by automobiles and pneumatic tubes. It is to be hoped that within half this time we shall have an aeroplane parcels post and special mail delivery system throughout the entire United States.

EARTHLIGHT.

THE Astronomical Laboratory at Groningen, Holland, has recently issued a memoir, in English, by L. Yntema, entitled "On the Brightness of the Sky and the Total Amount of Starlight," giving the results of an investigation of the relative and absolute brightness of different parts of the starlit sky, undertaken primarily for the purpose of determining the distribution of the stars in galactic latitude. In the course of his discussion of the absolute illumination of the sky, the author gives an account of the little-known phenomenon of "earthlight."

On a moonless night, when the sun is more than 18 deg. below the horizon and twilight is therefore at an end, it is observed that the general illumination of the sky increases toward the horizon—which would not be the case if it were due solely to starlight. It is also observed that on some nights the sky is much brighter than on others, without any corresponding difference in the brightness of individual stars, as measured with the photometer. Several cases of abnormal skylight on moonless nights have been recorded. As early as 1788, H. B. de Saussure mentioned an observation, on the Col du Géant, of a pale but clearly visible brightness all over the sky, gradually decreasing toward the zenith, and similar observations have been recorded subsequently by Humboldt, Bessel, Burkhardt, Galle, Agassiz, and many others.

It is especially significant that the occasional abnormal brightness of the sky sometimes occurs in cloudy weather, and even in a dense fog. Moreover, the sky is apparently never absolutely dark, for even with heavy clouds and not a star to be seen, Dr. Yntema has obtained a measurable impression on a photographic plate after half an hour's exposure.

A certain amount of the light of the sky on a starry night, but only a very small part, is due to diffused (as distinguished from direct) starlight. Taking the light of a star of magnitude 1 as the unit of measurement, Yntema finds that a square degree of the sky near the zenith had a total illumination, on certain nights, varying from 0.08 to 0.16, of which he computes only 0.02 (of the same unit) to be due to diffused starlight.

Bringing together all the evidence, Yntema agrees with the view more or less clearly hinted at or expressed by several earlier writers that the part of the illumination of the sky not due to diffused starlight is the effect of a *permanent aurora*, not confined to a particular part of the heavens, but overspreading the whole sky, and (we may presume) common to all parts of the world. According to Yntema's terminology, *earthlight* includes both the diffused starlight and this supposed auroral glow; but it appears to us more advisable to limit the application of the term to the latter phenomenon, which would otherwise lack a distinctive name.

That earthlight is auroral in character appears to be established by the fact, observed in recent years by Angström, Vogel, Campbell, Arrhenius, and others, that the characteristic green line of the auroral spectrum—generally attributed to krypton—may be observed in all parts of the heavens on almost any clear night.

COST OF MARKSMANSHIP.

WE ARE justly proud of the records that our naval gunners have made in past years, yet it is doubtful if the average person knows that it costs this government something like a million and a half dollars a year to secure and hold that record.

After the close of the Spanish war the Navy Department officials realized how much powder and shot had been used. Target practice began then in earnest, and it was brought home to every one that "it's the shots that hit that count."

In 1903 the yearly cost of target practice per ship was about $50,000. It can be readily seen how this government can spend such an amount with her new and improved type of ships.

There are so many indirect expenditures connected with target practice that it is almost impossible to get at the real outlay. One of these is the deterioration of the guns.

Take for instance the ordinary twelve-inch rifle. Its life is limited to about 150 shots, after which it must be thoroughly overhauled to render it fit for service again. It must be considered, however, that a twelve-inch gun fires a 1,000 pound projectile, has a velocity of about 2,500 feet per second and uses over 360 pounds of smokeless powder.

Another heavy item which is not figured in the naval appropriations is the life-size targets—such vessels as the old ram "Katahdin," the coast defense vessel "Florida," used some time ago when tests were made with the new military mast, and others. Of course after these vessels had been fired upon and injured to a great extent, much money was spent for repairs, but the men had the target practice, exactly as though they were in actual warfare, and in some cases under conditions that were rather severe.

When it is considered that our navy holds the world's record for shooting with big guns, then the amount expended for such target practice seems small in consequence.

The rainiest place on the continent of Europe, so far as meteorological records show, is Crkvice, in the mountains of Dalmatia, back of the Bay of Cattaro. The monthly rainfall at this point for the past twenty-two years is published in the current number of the Meteorologische Zeitschrift, and gives a mean total rainfall for the year of 4,642 millimeters (182.76 inches). The wettest year was 1901, with a rainfall of 6,135 millimeters (241.53 inches).

ELECTRICITY.

A novel method of demonstrating the advantages of electricity in the household has been adopted by the Edison Company of Boston. A house has been fitted up with all useful appliances, care being taken to eliminate such apparatus as would come under the head of mere novelties. This house is portable, and will be set up in the various towns reached by the lines of the company. Demonstrations of electrical kitchen work, laundry work, house cleaning, etc., will be given each evening.

A German surgeon has been experimenting with high-frequency electric current, with a view to stopping the flow of blood during surgical operations. He finds that by the application of the current, the blood can be coagulated in the region of the operation. It is claimed that this system is of particular value in the treatment of surface cancers, and it has been employed to advantage in the removal of tonsils. There is, however, the danger of coagulating the blood in the large veins, against which steps must be taken.

A canvass was recently made of the electrical engineering alumni of the Worcester Polytechnic Institute, to discover what salary the men who have taken up this line of work can demand. The average incomes ran from $1,000 per year on the second year to $2,000 on the eighth, over $5,000 on the sixteenth, and $9,000 on the twentieth year. The highest paid men reached $8,000 on the fourteenth year after graduation, while the lowest paid men took twenty years to reach a salary of $5,000.

The course of lectures on illuminating engineering given at Johns Hopkins University in connection with the meeting of the Illuminating Engineering Society at Baltimore, has proved to be successful beyond all expectations. It was first planned to provide for an attendance of a hundred at these lectures; but before they opened two hundred and thirty names had been registered, and it was necessary to provide additional accommodations. Illumination as an art is in its infancy, and the value of this course of lectures cannot be overestimated.

The Iron Trade Review recently called attention to the fact that motors installed in machine shops are frequently too large, owing to the fact that the exact amount of power required is not definitely known. As a motor is most efficient at full load, the result is that there is an undue loss of efficiency. A number of cases are cited wherein the exact amount of power required was determined by means of volt meter and ammeter readings, showing that the motor in use was of too high a power, and after this motor was replaced with one of the required power, a considerable economy of power was effected.

The Bureau of Steam Engineering of the United States Navy has just issued a directory of all wireless telegraph stations in commercial use as well as those of our army and navy. Stations belonging to the navies of foreign governments are not included. The total number of stations listed is 1,520, about 700 of which are shore stations. On our Atlantic and Gulf coasts there are 88; on the Pacific coast, 51; on the Great Lakes, 48, and in Alaska, 16, in addition to which there are three in the interior of the United States. There are 334 naval vessels equipped with wireless apparatus, and 821 merchant vessels.

Owing to the fact that the coefficient of expansion of platinum is almost identical with that of glass, platinum leading-in wires fused into incandescent glass bulbs are used in order to prevent the danger of leakage of outside air into the vacuum chamber within the bulb. A cheaper system is being tried in London. In place of platinum, a small steel tube is used as a cap. This is embedded into the glass while it is hot, and afterward is soldered to the wire leading from the bulb. The tube contracts, and forms a tight seal between its inner surface and that of the glass embedded into it. This seal appears to be successful; tubes that were exhausted to a high vacuum for use with cathode rays are found to be still in good condition after four months' use.

In a recent number of the Electrical World, there is an article on the patents of Thomas Edison. His first patent was secured in June, 1869, on an electrographic vote recorder. Since then 905 patents have been issued to him, 713 of which pertain to electrical apparatus. His greatest activity was in the years 1881 and 1882, when he was concerned with the development of the incandescent lamp and power machinery. In 1882 he was granted 75 patents, and the year before he secured 69 patents. From 1890 to 1892 there was another period of activity, as shown by the number of his patents, which was 65, 32, and 65, respectively, these being devoted mainly to the phonograph and to electric light and power machinery. Considering all the patents that are probably pending, patents that were withdrawn, and patents not yet filed but in the course of preparation, it is estimated that the number of Edison's inventions is close to 2,000.

SCIENCE.

Prof. Frank H. Bigelow, who recently resigned from the United States Weather Bureau, has joined the staff of the Argentine Meteorological Office.

Prof. T. H. Richards, of Harvard University, has been awarded the Davy medal of the Royal Society for his researches in the determination of atomic weights.

Señor José Galbis has been appointed chief of the Instituto Central Meteorológico at Madrid, and hence of the national weather service of Spain. He succeeds the late Augusto Arcimis y Wehrle.

To Prof. William H. Brewer, who died in New Haven on November 3rd, belongs much of the credit for the purchase of Alaska. It was he who was largely instrumental in persuading President Johnson and Secretary Seward of the advisability of that step.

What is the number of the stars? No one knows. Every improvement in the art of photography seems to reveal more and more stars; and, according to Sir George Darwin, it is perhaps not excessive to guess that even to-day a thousand million might be counted.

The Tiflis Physical Observatory, which is the headquarters of a *réseau* of meteorological stations covering the whole of Transcaucasia, is about to establish a meteorological observatory on Mount Ararat. It will be open only during the summer months, and will be connected by telephone with a base station.

Dr. H. W. Harding observes in a recent report published in the Lancet, that most waters, if treated with one part of chlorine per 1,000,000 for fifteen minutes, would be free from the cholera vibrio. In spite of its irritating properties, chlorine in such minute quantities is not likely to affect the palatability of drinking water, so that this method of purifying water should be of considerably industrial value.

A cholera boat has been designed and built by Thornycroft in Russia to the order of the railway department of the Russian government. She is primarily intended for the use of the medical officer in the Wilna district of Russia, where she will be employed in transferring patients suffering from cholera, from the outlying districts to the hospitals. To this end, the after part of the boat is fitted up very completely as a small floating hospital.

The United States Weather Bureau has published a revised edition of C. F. Talman's "Brief List of Meteorological Text Books and Reference Books," a select bibliography of meteorology, embracing upward of 150 titles, classified under seventeen heads, and provided with explanatory notes. Notwithstanding the fact that a complication of this kind undoubtedly allows some opportunity for personal bias in the matter of selection, it is highly desirable that similar bibliographies should be made for each of the sciences, for the guidance of all students who are not specialists, and especially as an aid to librarians in selecting appropriate literature for their collections. Mr. Talman is the librarian of the Weather Bureau, and is qualified by many years' experience in dealing with meteorological literature to make a careful selection.

A description of the new mammoth cave in Europe has been published by Hermann Boch, recently discovered near Obertraun in Austria. The cave is situated under the Dachstein, a mountain in Upper Austria 9,800 feet high. The entrance is at an elevation of about 4,500 feet. Among the characteristic features of the cave is a natural tunnel, at the bottom of which is a river bed six feet deep, formed by an early stream. This tunnel leads to a precipice. Still another feature is a gallery 150 feet high, which leads to a series of stalactite caverns. Like many another cave throughout the world, the Austrian cavern has its dome, 340 feet high, with a cone-like heap of debris 250 feet high in the center. From this central dome radiate a maze of other domes and galleries, many of which end precipitately in dark abysses.

The subject of atmospheric electricity has been wellnigh made over during the past decade, owing especially to the recent discoveries along the lines of ionization and radioactivity, with the result that its terminology has far outstripped the dictionaries. The literature of the subject in its present form is mainly in German, in which language the vocabulary is becoming fairly well fixed; but writers in English find it difficult to ascertain the best usage as to the technical terms they should employ. We therefore welcome the appearance in September number of Terrestrial Magnetism and Atmospheric Electricity of an extensive "Glossary of Atmospheric Electricity Terms," compiled by Dr. W. W. Strong. Although this publication is timely and useful, we notice several striking omissions; e. g., *potential gradient, equipotential surface,* and *earth-air current.* The terminology of the thunderstorm, and that of the aurora (e. g., Weyprecht's classification of the auroral forms) are almost wholly overlooked, and an especially regrettable omission is the group of terms relating to thunderstorm recorders, such as *ceraunograph, ceraunogram, ceraunophone, isoceraunic zone,* and *brontometer.*

AERONAUTICS.

An enterprising director of amusements has planned a traveling circus for aeroplanists. He intends to make contracts with aviators, and to convey them and their machines by special trains all over the country to give exhibitions.

For the third time within a month, an airship has successfully crossed the English Channel. A young Welshman named Ernest T. Willows, who recently flew from Cardiff to London, ascended on November 5th at Wormwood Scrubbs, and started off for Paris. He landed at Douai, fifty miles inland from Calais, because his gas-bag leaked and because he had lost his map. In alighting, the frame of his airship was slightly damaged.

On the 3rd of October, at 20 minutes after 5 in the afternoon, Tabuteau left St. Sebastian for the purpose of crossing the Pyrenees. He rose immediately to a height of 800 meters. He passed between the peaks of Haya and Jaizquibel. Dropping down at Fontarabia, he followed the valley of the Biddassoa. He continued on his route by way of St. Jean-de-Luz, Guethary, and passed over the plaza of Biarritz, to the plaudits of an immense crowd.

Besides the super-urban flight above mentioned, Latham won the duration prize the first day of the meet by remaining aloft 47½ minutes against Count De Lesseps' 32:42. The wind was too gusty for record altitude flights, but Drexel and De Lesseps scored 1,886 and 1,722 feet, respectively, with their Blériot monoplanes. Two days later Mr. Drexel reached a height of 4,885 feet in his Blériot, and Hoxsey attained an altitude of a mile in the same small Wright biplane that Johnstone drove to the record height of 9,714 feet at Belmont Park. While descending his motor stopped. Hoxsey made a 3,000-foot dive at an angle of about 45 degrees and landed in a plowed field three miles away. The short skids caught and turned the machine over. It was damaged considerably, but Hoxsey was unhurt.

Lieut. Bellinger, who distinguished himself during the recent army maneuvers as a scout, has been promoted to captain. He signalized his promotion by a remarkable flight. On the 29th of September he left Vincennes, carrying an order of Col. Estienne to be delivered at the camp of Sissonne (Aisne). He reached his destination without accident. From Sissonne he repaired to Mourmelon, and intended from that place to return to Vincennes. Unfortunately, a violent storm broke out, which compelled him to come down between Villeres and Bry-sur-Marne, that is to say, some kilometers from Vincennes, at a spot where a monument has been erected to a German colonel killed during the war. Capt. Bellinger thus covered about 400 kilometers (248 miles), which is certainly a remarkable performance. Bellinger telephoned to Vincennes for aid, and found it impossible to make telephonic connection. A tramway official refused to help him.

The first use of an aeroplane for carrying express matter was made by the Wright brothers on November 7th, when one of their biplanes, piloted by aviator Phil. O. Parmalee, left the Wright's aerodrome at Simon's station, near Dayton, O., at 10:45 A. M. and landed at Columbus, O., 65 miles away, 66 minutes later. Strapped to the passenger's seat of the biplane were two bundles of silk weighing about 100 pounds and valued at $800. A stock Wright biplane, fitted with a 30 horse-power 4-cylinder motor, was used, and owing to a favorable wind of 20 miles an hour velocity, the aeroplane actually covered 62 miles across country in 57 minutes. Parmalee therefore made an average speed of 65¼ miles per hour and set up a new record for a cross-country flight. This flight demonstrates how useful the aeroplane will yet become for the carrying of express and mail matter. Postmaster-General Hitchcock, after a flight with Count De Lesseps at Baltimore, expressed his intention of beginning experiments in mail carrying by aeroplane at once.

The bad storm of the third instant blew down the tents in which many of the aeroplanes for the Baltimore meet were sheltered, and demolished or seriously injured most of the machines that were under canvas. The meet was necessarily postponed for several days. Latham, fortunately, had not unpacked his Antoinette monoplane, which consequently was not injured. On the opening day of the meet, Monday, November 7th, at 12:16 P. M. Latham left the Halethorp aviation field and flew for 42½ minutes above the city. He passed first over Ft. McHenry, and then above the Baltimore Sun building (which paper paid him $5,000 for the flight). He also passed over Patterson and Druid Hill parks, besides traversing the business district of the city and making a detour around the residence of Mr. Ross Winans, an invalid millionaire, who paid Latham $500 for exhibiting his machine in flight. The flight was made in a 20-mile wind, and was hailed with delight by inhabitants of the Oriole city.

PARACHUTE CLOTHES FOR AVIATORS.

Not until aviation is far safer than it is now, will it compete with automobiling as a popular sport. The death list of aviators has reached an appalling figure, and the accidents to expert flying men are numberless. Under such circumstances, there is little to encourage a novice in taking up the art of flying, unless he is a reckless man and cares little for his personal safety. Undoubtedly the flying machine is safer at a considerable height above the earth than when flying close to the ground, for the reason that it is not so subject to disturbing gusts; and in case of accident to the motor, the operator of the machine can glide to earth, and will have a better opportunity to pick out a safe landing place. What the aviator most dreads is an accident to his motor when he is close to the ground on which a landing is impossible. The failure of his motor or an unexpected puff of wind may dash him to the earth before he has time to recover.

In view of such dangerous possibilities, efforts have been made to provide the aviator with safety appliances calculated to break the shock of the fall, but it is obviously impossible to safeguard against harm by furnishing him with padded clothing. Another scheme has recently been suggested and carried in practice with a fair degree of success. Its object is not to take the shock of the fall, nor is it to prevent a fall (for obviously the aviator wishes to come to ground), but to reduce the rate of falling on the principle of a parachute. In order to make the parachute immediately accessible (for in time of accident near the ground the aviator has scarcely time to think), it is made a part of his wearing apparel, and may be put into use by the involuntary action of the arms when he begins to fall. The parachute is in the form of a loose flowing garment, which is securely fastened to the body, and is fitted over a framework carried on the aviator's back. The lower ends of the garment are secured to the ankles. The arrangement is such that when the aviator throws out his arms, the garment is extended, and during the fall is puffed out by the air, thus serving as a cushion to prevent too rapid a descent. Experiments have been made with this parachute dress, in which the wearer has jumped from buildings and other heights, and the garment has been puffed out into a parachute at once. The accompanying illustrations show very plainly how the garment is worn, and the position it assumes as the aviator is dropping through the air.

PARACHUTE GARMENT EXTENDED PREPARATORY TO GLIDE.

A SAFE GLIDE FROM A CLIFF.

NEW PROCESSES IN THE MANUFACTURE OF SUPERPHOSPHATES.

Although the superphosphate industry is scarcely fifty years old, it has acquired an enormous development. The world's annual output of superphosphates exceeds ten million tons. In the modest beginning of the industry, the mineral phosphate of lime or ground bone was mixed with sulphuric acid in a tub, with the aid of a hoe, exactly as mortar is mixed. The temperature of the mixture rose rapidly. Water vapor and volatile acids were evolved, and the mixture, left to itself for a few hours, set in the form of a block, which was allowed to cool, broken, and pulverized as well as possible. The result was a wet and sticky fertilizer which was difficult to spread on the ground. Mixing machines, ventilating chimneys for the removal of acid vapors, and other improved appliances were successively introduced, including closed pits, in which the mixture was allowed to set and cool; pulverizers, which reduced it to a more or less sticky powder; drying machines, which removed the excess of water and gave to the product a consistency and hardness which made it easier to grind and apply; and, finally, various machines which supplanted the greater part of the workmen, such as elevators, cars, bucket chains, belt conveyors, mechanical sieves, and automatic chargers.

This is the equipment of the numerous superphosphate factories, some of which have a daily capacity of one hundred and even two hundred tons of fertilizer. Nearly all of these establishments possess the forms of apparatus enumerated above. It is not my purpose to describe this well-known apparatus, the introduction of which has diminished the cost of production to a very low figure, which is an indispensable condition for the manufacture of a product of small value in proportion to its weight. This product and its manufacture, as it is ordinarily conducted, possess numerous defects.

In the first place, the superphosphate, which is at first soft, becomes converted in the course of a few hours into a tough, sticky mass or cake, the removal of which by manual labor from the pit in which it has accumulated is a very laborious and disagreeable operation. Although the mass is allowed to cool as much as is practicable, the men are obliged to work with picks and shovels in a hot and moist atmosphere contaminated with injurious gases. Although mechanical ventilators are used, it is necessary to relieve the men every half hour, and the work advances slowly because only a few man can be employed at once. Hence every factory must have a number of mixing pits. This part of the manufacture is necessarily very laborious.

In the second place, the drying process, which is compulsory with most superphosphates in consequence of the legitimate demands of purchasers, who have been accustomed to a dry superphosphate powder by the well-equipped factories, requires the employment of enormous and costly apparatus, which soon wears out, is difficult to keep in repair, and consumes large quantities of fuel.

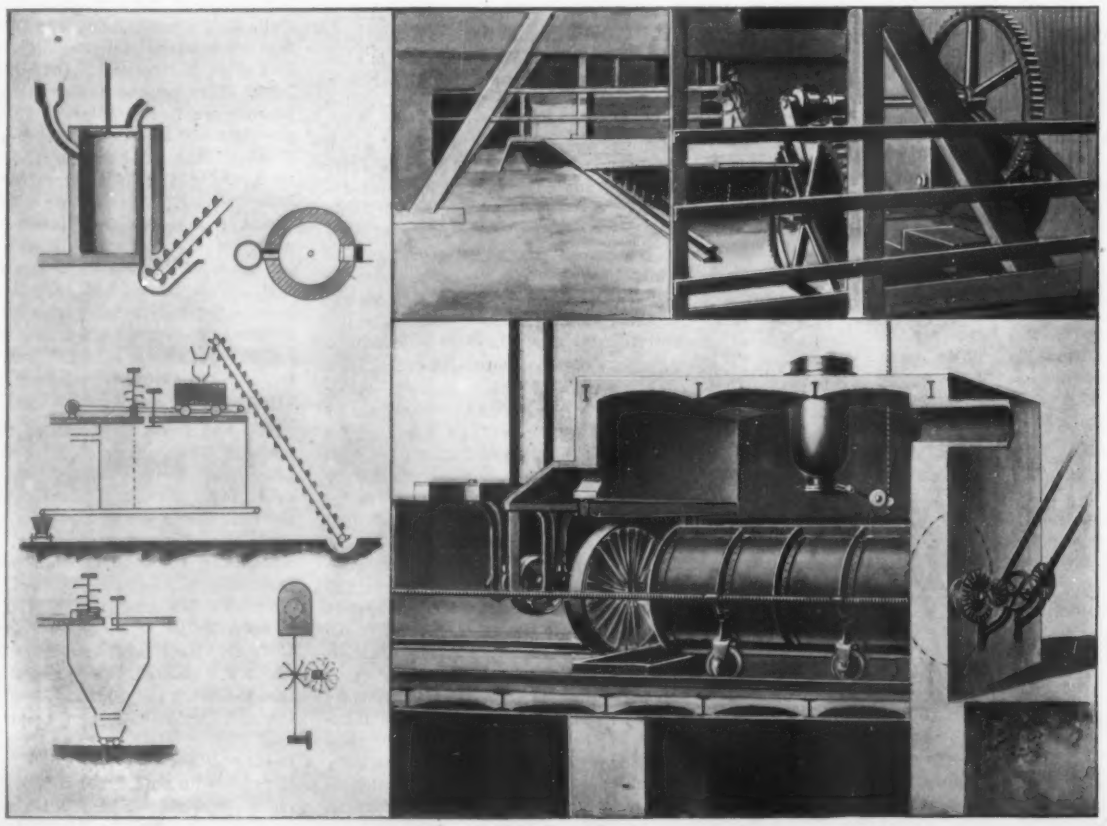
This is not all, for if the superphosphate is too strongly heated in the drying apparatus it retrogrades, that is to say, it loses solubility. When it is stored in this condition, it tends to cake again, so that it is necessary to break it up mechanically before it can be bagged and shipped. This introduces another apparatus.

Many inventors have endeavored to obviate these inconveniences, and within the last few years several new forms of apparatus have appeared, which diminish the amount of manual labor required, eliminate the operations of drying and grinding, and give to the new factories an automatic operation, which is entirely different from that of the old ones. The most important of these devices are briefly described below.

The operation of mixing as performed by the new machines differs from the process in common use chiefly in rapidity, half a ton being mixed in a minute or two. All of these machines work intermittently.

The three automatic systems described below are based on the same general principles. In the Overmann apparatus, the mixing pit is a round brick tower 16 to 20 feet high and some 10 feet in diameter. It is closed at the top and has only two openings, one for

(Continued on page 408.)



Redrawn From La Nature

NEW PROCESSES IN THE MANUFACTURE OF SUPERPHOSPHATES.

A MECHANICAL WATER RECORDER

AN INSTRUMENT THAT MEASURES THE AMOUNT OF WATER FLOWING OVER A WEIR

The demand for apparatus by which the flow of water can be accurately measured and recorded is constantly increasing as water becomes less plentiful and more valuable for the production of power and for other uses. The recent development in steam-engine research and the necessity of keeping records of the consumption of steam, and therefore of water, by the great steam plants of modern factories and electric generating stations have been powerful incentives to the invention of automatic devices for measuring and recording the flow of water with accuracy and convenience.

One of these devices is the Lea patent water recorder, an English invention, in which an ingenious use is made of certain theoretical laws, which have long been known, regarding the flow of water over weirs and notches. The working formulas which have been deduced from these laws, in conjunction with experiments, have been found sufficiently accurate for most practical purposes.

When water flows from a tank or reservoir over a horizontal sill extending over the entire width of the outlet channel, the formula employed, known as Francis's formula, is:

Cubic feet per *second* — 3.33 $LH\sqrt{H}$.

in which L is the width, in feet, of the sill or channel and H is the depth, in feet, of the top of the sill below the undisturbed surface of the water in the reservoir. If the flow is confined to a sharp-edged rectangular notch, with a horizontal base of less width than the weir, the same formula is used, but in this case L is the width of the notch in feet. These are the commonest forms of weirs, and Francis's formula gives the flow with a fair degree of accuracy, but far greater and almost perfect accuracy can be obtained by employing a sharp-edged V-shaped notch. Prof. James Thompson, who has made a study of the V-shaped notch, gives the following formula for the flow, when the angle of the notch is 90 deg.:

Cubic feet per *minute* = 0.305 $H^2\sqrt{H}$.

Where H is the depth, in *inches*, of the bottom of the notch below the undisturbed surface of the water.

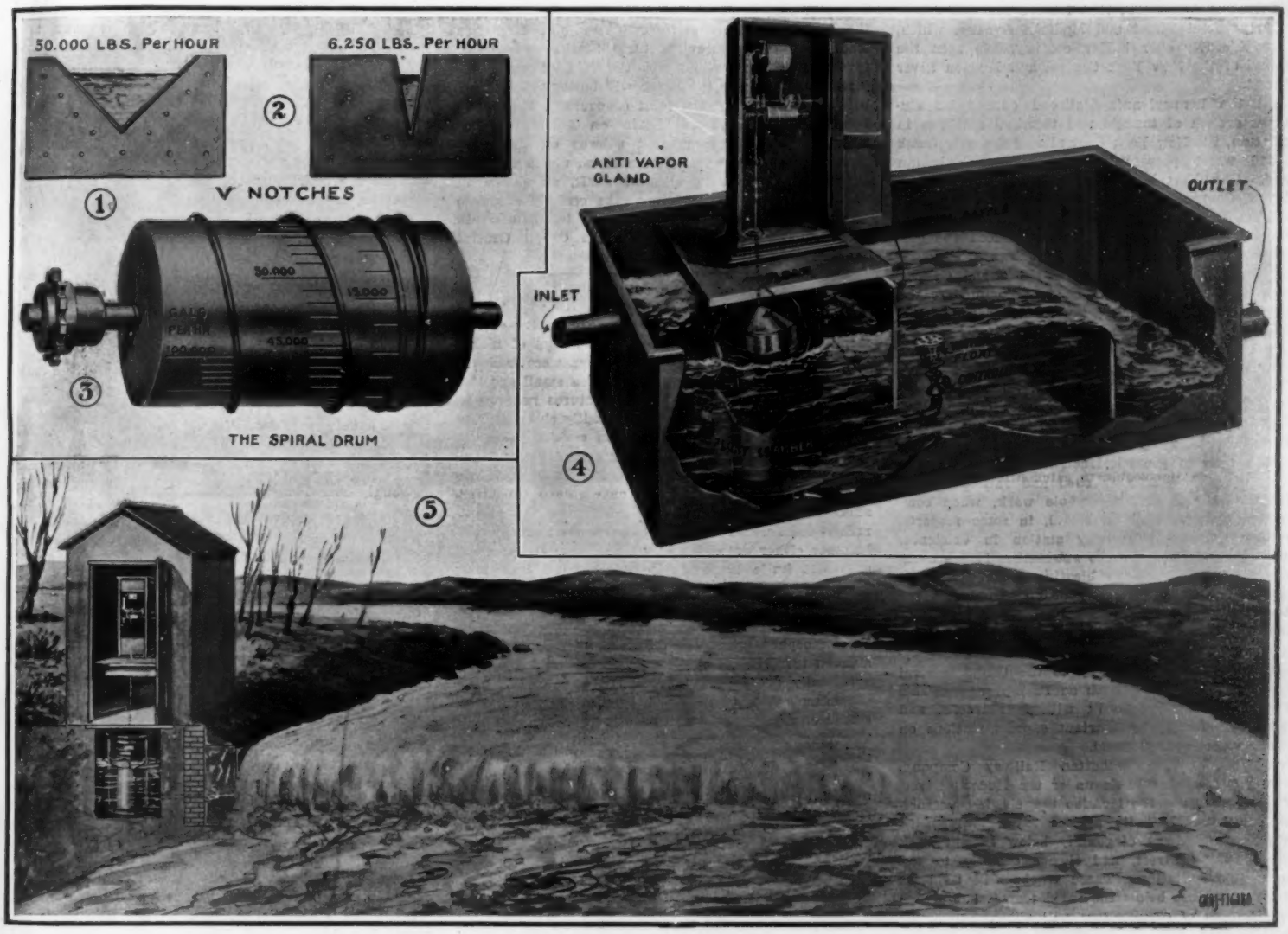
The section of the flow through this notch remains unchanged in shape, though its area may vary, and this constancy of form tends to simplify the formula and make it accurate. For this reason, and also because the V-shaped notch is especially well adapted for the measurement of small quantities of water, it has been adopted in the Lea recorder for cases requiring such measurement.

The narrower the notch, the smaller is the flow that can be accurately measured, and notches of different angles are employed, according to the flow. The sharper notches are as accurate as the notch of 90 deg., and Thompson's formula applies to them equally well, when the proper changes are made in the numerical coefficient.

If a float is placed in the reservoir and attached to a pen in contact with a sheet of paper which moves horizontally with uniform speed, the ordinates of the curve thus traced will represent the heights of water at various instants, from which the corresponding rates of flow can be calculated by Thompson's formula. In the Lea recorder this calculation is performed automatically by the mechanism that moves the pen, which consequently draws a curve whose ordinates are proportional to the rates of flow and whose area represents the total quantity of water that has passed through the notch in a given interval of time. This area, like that of the indicator diagram of a steam engine, can be obtained by means of a planimeter. The principle of the device by which the pen is caused to move in accordance with the rate of flow will be explained in connection with the description of the Lea recorder, which is shown applied to a tank, in Fig. 4. The float is inclosed in a separate float chamber which communicates with the main body of water only through a one-inch pipe controlled by a valve, so that the surface of the water inside the chamber shall be undisturbed by waves and yet shall rise and fall with the mean water level outside. The float has the form of a short vertical cylinder or hollow disk and is usually about 12 inches in diameter. The recording apparatus is inclosed in a cabinet which stands on the top of the float chamber and if necessary is protected from the weather by a hut. (Fig. 5.) A vertical rod which passes through an anti-vapor gland, in order to protect the apparatus from moisture, rises from the top of the float and terminates in a rack which engages with a pinion on the horizontal shaft of a drum, which is shown separately in Fig. 3. A wire, which constitutes the guide by which the recording pen is caused to move in accordance with the rate of flow, is coiled on this drum in the manner now to be explained.

If the rate of flow corresponding to various depths of the apex of the outlet notch below the surface of the water is calculated by Thompson's formula and plotted as a function of the depth, the points thus established will lie on a curve of the parabolic class, which may be called the curve of flow.

If this curve is drawn on paper, to the proper scale, and the paper is wrapped about the drum so that the abscissas, representing depths of water, are perpendicular to the axis of the drum, and the ordinates, representing rates of flow, are parallel to the axis, the curve will indicate the position which the wire guide must occupy. A peg at the lower end of a vertical rod is pressed against the guide thus formed. The vertical rod is rigidly attached to a horizontal rod placed between two pairs of rollers which allow it to move freely in a horizontal direction but prevent it from moving up or down. To the horizontal rod is attached a second vertical rod which carries a pen at its upper end, and this pen is in contact with the paper-covered recording cylinder shown at the top of Fig. 4, which is turned uniformly by clockwork about its horizontal axis, usually at the rate of one revolution in 24 hours. It is evident from this description that the angular displacements of the guiding drum, governed by the rack and float, correspond to the variations in the head of water, and that, consequently, the horizontal displacements of the pen, controlled by the guide which represents the curve of flow, correspond to the variations in the rate of flow. Hence, as the recording cylinder turns with uniform speed, the pen traces a curve which gives the rate of flow for every instant. At the same time the actual rise and fall of the water in the tank or reservoir is shown by a pointer attached to the float spindle and moving



A MECHANICAL WATER RECORDER.

over a vertical scale of inches, while the actual rate of flow is shown by the position of the guiding point on a scale inscribed on the guiding drum. (Fig. 3.) As this scale is about 20 inches long in an apparatus in which the maximum movement of the float is only 4½ inches, the variation in the flow caused by a change of level of 1/200 inch can thus be detected. This accurate instantaneous measurement of the flow is very useful in testing steam engines.

The Lea recorder has been applied, in conjunction with outlet notches of various angles, to a great variety of purposes, but especially to the measurement of condensed steam and boiler feed water in large power stations. Though usually applied to a weir having a V notch, it can be used as well with any other form of weir for which the formula for the flow is known.

A GREAT SUBTERRANEAN RAILWAY JUNCTION.

The great activity in the construction of underground tunnels, which is a notable feature in the engineering work of the great cities of the world, is nowhere so strikingly exemplified as in the city of New York.

We have selected, as illustrating in a startling way the extent of this work, that famous railroad center on Forty-second Street and Madison Avenue, which, for considerably over half a century, has been the terminal of the New York Central and Hudson River Railroad.

Until the Pennsylvania Railroad opened its stupendous system of tunnels and terminal facilities in Manhattan, the New York Central was the only trunk railroad which possessed a station on Manhattan Island. The New York, New Haven and Hartford Railroad Company, which runs its trains into New York, has been using the same terminal under lease.

Shortly after New York city commenced the construction of its present system of subways, the New York Central, realizing that the old Grand Central Station was entirely inadequate to accommodate the heavy traffic of its own and the New Haven systems, planned the reconstruction of its terminal on a greatly enlarged scale; and, in order to secure ample accommodations for the future, it determined to place the station yard entirely below street level and arrange its system of tracks upon two separate levels, building a double-deck sub-station. At the same time it was decided to equip the whole terminal and the suburban lines for electric traction. The plans called for the erection of a train shed and railroad offices above the tracks, and the whole work, when completed, will form the largest and, in some respects, the most impressive railway station in existence. The mere excavation for the sub-station is a stupendous work, calling for the blasting out and removal to a point outside of the city of no less than three million cubic yards of rock.

The present rapid transit subway, in traversing the length of Manhattan Island, runs through Forty-second Street from Broadway to the Grand Central Station, where it turns south on Park Avenue. This section of the road is built with four tracks, and here one of the most important express stations on the whole system is located.

The Hudson and Manhattan Railway Company, which operates the tunnels under the Hudson River, popularly known as the McAdoo tunnels, is constructing an extension of its system from Thirty-third Street and Broadway diagonally below Bryant Park to Forty-second Street, and thence easterly to the Grand Central Station. These tracks will be built at a level as close below the rapid transit subway as the exigencies of construction will allow.

On the next level below the Manhattan Railway tracks is the tunnel of the New York and Long Island Railway, popularly known as the Steinway tunnel, which extends from Long Island below the East River and Forty-second Street, to the Grand Central Station.

At street level on Forty-second Street are the tracks of the Forty-second Street surface railway, and above these is the terminal of a short spur of the Manhattan Elevated Railway, which runs up Forty-second Street from Third Avenue to the Grand Central Station.

It will thus be seen that at this important center, where the largest trunk railroad terminal station in the world is being built, there will be centered, as feeders thereto, no less than five distinct transportation systems, superimposed one above the other. The upper three, that is, the elevated railway, the surface trolley, and the rapid transit subway, place the Grand Central Station in touch with the whole of Manhattan Island, the Bronx, and the heart of Brooklyn. The Hudson and Manhattan Railway will carry passengers to and from the Grand Central Station, and the terminal stations of the several trunk railroads in Jersey City, namely, the Delaware, Lackawanna and Western, the Lehigh Valley, the Susquehanna, the Erie, the Pennsylvania and the Jersey Central railroads. The New York and Long Island Railroad will enable passengers to travel directly from Long Island City and the outlying districts to the Grand Central Station.

Now, in order to provide quick communication between these several tunnel roads and the Grand Central Station, the New York Central Company proposes to build, immediately below the surface of Forty-second Street, extending from the rapid transit subway station to the Grand Central Station platform, a joint subway concourse, which will extend from the present subway station to Lexington Avenue. It will be served by an elevator of large capacity, that will carry passengers to and from the platforms of the three tunnel systems that concentrate at this point. The McAdoo system contemplates for its Grand Central extension the construction of a concourse beneath the northern half of Forty-second Street, extending from the westerly side of Park Avenue to the easterly side of Depew Place, with stairways connecting with the train platform on the third level below Forty-second Street. This Hudson and Manhattan, or McAdoo concourse, is intercepted by the main elevator shaft, as shown in our drawing, which serves both the McAdoo and the Steinway tunnels. There is a second elevator shaft, not shown in our drawing, connecting the McAdoo train platform with the Steinway tunnel platform. The joint concourse leading from the Grand Central Station works out favorably in connection with the McAdoo concourse just below it; since the latter will be located midway between the ends of the joint concourse. There will be connections with the Lexington Avenue subway on the east and the present subway on the west. Another advantage of these arrangements is that the entrance to the main elevator shaft, as shown in our drawing, is at the foot of the stairs leading to the Third Avenue elevated lines, and immediately in front of the main entrance to the Grand Central Station.

"Stellite," a New Alloy.

BY ELWOOD HAYNES.

About the year 1895, I made some tentative experiments relating to the production of alloys of nickel with iron, chromium, etc. The fusions were made in small graphite crucibles by means of a small gas furnace of the Fletcher type. Temperatures ranging to the fusing point of fire clay were readily obtained, and by this means I later succeeded in making alloys of nickel and chromium containing small amounts of carbon and silicon. A few years later I made an alloy of this description to which was added a small amount of aluminium. The metal was hard and rather brittle. It could not be worked under the hammer either hot or cold. I made from it, however, a pocket knife blade which was ground into final shape. It showed fair cutting qualities, and considerable resistance to atmospheric influences. It was readily soluble in nitric acid, and after long exposure to the atmosphere of the chemical laboratory, it showed a green tarnish.

I finally succeeded in producing an alloy of pure chromium with pure nickel by heating the mixed oxides of these metals with pure powdered aluminium. The reaction was so violent that the greater part of the alloy was thrown from the crucible. Some particles were saved, however, which showed great malleability, and after grinding them off on a carborundum stone, and afterward polishing, they exhibited a fine luster. I did not make a quantitative analysis of this alloy, but a chemical examination of it showed that it contained chromium in considerable quantity.

After some experimenting, I was able to produce metal that would forge out perfectly into thin strips, which showed no tendency to check. After cooling, these strips were as hard as mild tempered steel, and could scarcely be scratched by a file. A kitchen knife blade was made from this material, and used for all sorts of purposes, such as are known only to the culinary art. After two years of use, it showed not the faintest sign of tarnishing, and if held in the sun it produced a reflection that would dazzle the eyes.

PHYSICAL PROPERTIES.

In color, the metal stands between silver and steel, and if suitably polished it shows a high luster. I have thus far made no physical tests of the forged metal, but a cast bar showed an elastic limit of 79,000 pounds, an elongation of 3 per cent, and an ultimate strength of 96,000 pounds to the square inch, cross section. A test was also made of the modulus of elasticity of the material, which was found to be fully equal to that of steel. These tests were made on one of the first bars produced, and I am pretty well satisfied that much higher results could now be obtained.

Notwithstanding the great hardness of the alloy, it not only forges readily at a red heat, but can be bent at a right angle cold, either in the form of a cast or forged bar, provided the dimensions do not exceed one-fourth inch square. Its elastic limit is not quite equal to that of tool steel of the same hardness, but it is much tougher. Samples can also be made showing much greater hardness than those described above, but the breaking strain and elastic limit will, under these circumstances, closely coincide.

Blades made from the alloy take a fine cutting edge which is particularly smooth, though capable of excellent cutting qualities.

The coefficient of expansion of the alloy has not yet been determined, but it is probably quite low, approximating pretty closely that of glass, since a small Stellite wire can be sealed into a glass tube, making an air-tight joint, without cracking the glass.

VARIETIES OF THE ALLOY.

What has been said above relates principally to the alloys of cobalt and chromium, containing approximately 75 per cent of the former, and 25 per cent of the latter metal. A great variety of alloys can be obtained by varying the percentages of the constituent metals, as well as by adding small quantities of other substances. I have prepared alloys of cobalt and chromium containing as high as 20 per cent platinum, but have found that they do not resist chemical reagents so well as the binary alloys of cobalt and chromium. I have produced non-oxidizable alloys, proof against nitric acid, which were so soft that they could be readily filed. Other modifications of the alloy are so hard that they will readily scratch glass, or even quartz crystal. These latter, however, are most of them rather brittle. Between these two extremes a great variety of alloys may be formed which are suitable for various purposes, according to requirement.

CHEMICAL PROPERTIES.

More than ten years ago I discovered that the alloys of both cobalt and nickel with over 10 per cent chromium were practically proof against nitric acid of all strengths, hot or cold. A brightly polished piece of the cobalt-chromium alloy is attacked slowly by cold, strong hydrochloric acid, and after the lapse of a few seconds, the solution shows a faint greenish tint.

Either strong or dilute sulphuric acid attacks the metal very slowly. It is a singular fact that if a small amount of potassium bichromate be mixed with the sulphuric acid the action is almost *nil*. Just why this is true is somewhat difficult to understand, since under these circumstances, a mixture of chromic and sulphuric acids is produced, which usually shows very violent oxidizing properties.

Hydrofluoric acid also acts very slowly on the alloy, and its action seems to be similar to that of hydrochloric acid, though not so pronounced. With the exception of the above acids, the alloy is practically inert to all other chemical reagents. A polished piece may be boiled in nitric acid for hours without having its luster diminished in the slightest degree. The alloy may also be boiled in solutions of the caustic alkalies for an indefinite length of time without without the slightest effect. It is likewise proof against all atmospheric influences, and will retain its luster under all circumstances, no matter whether the atmosphere is dry or moist, or even heavily laden with acid vapors, sulphureted hydrogen, or other corrosive gases. It may be placed in saline solutions of the caustic alkalies, and allowed to remain for days, or until the solution completely evaporates, leaving the metal imbedded in the solid residue, without the slightest effect.

When the 25 per cent alloy is heated in the air it retains its luster up to a temperature of about 350 deg. C., and then assumes a pale yellow color which, as the temperature rises, gradually deepens, becoming full yellow, orange, purple, and finally blue-black, after which it may be heated to whiteness without further change. It never shows the slightest tendency to scale when worked under the hammer; and while a finished hammered bar shows a dark, blue-black color, it also presents a glossy surface, provided the hammer used in drawing it had a smooth surface. This film of oxide seems to prevent the bar from further oxidation.

The Illinois traction system comprises some 550 miles of interurban electric track, which includes two stretches of 172 miles and 227 miles. Recent reconstruction work has included the re-equipment of nearly 100 miles of single-phase railway and the design and foundation work for a 28,000 horse-power plant. The new power plant is at Venice, Ill., and at present contains a 1,000-kilowatt engine-driven generator, a 3,000-kilowatt and a 5,000-kilowatt Curtis turbine. The reconstruction work has included the change over of 80 miles of track from 3,300 volts alternating current to 600 volts direct current. Difficulties were experienced in the service owing to the 80-mile alternating-current section being so small by comparison with the direct-current sections. The 83 miles are covered in the running time of 3 hours 10 minutes. A new feeder was put in to augment the capacity of the overload conductor. This feeder was a No. 000000 solid copper, and 105 miles were put in. This is said to be the largest order yet given for this size of feeder. This conductor has been found to give better results than two No. 0000 feeders; it heats slower, requires fewer joints and costs less to erect.

Correspondence.

A SUBMARINE CONFERENCE.

To the Editor of the SCIENTIFIC AMERICAN:

The more and more numerous accidents happening lately to submarine boats, the insufficiency of means for safety, and the extreme difficulties which have opposed their appliance, have caused me to propose an international conference to which should be invited the best-known constructors of submarine vessels, as well as a submarine-boat commander of every state having such boats in use.

This conference shall be held at Berlin in the near future, and it shall be the object of the meeting to consider, in the interest of the brave officers and crews of such boats, just what kinds of means for saving the crew of submarine vessels in time of danger are already known, how these means have proved themselves so far, and above all to deliberate in what manner they may be improved upon.

Personal information gained through interested parties has proved to me that the idea finds much sympathy. I would respectfully ask that all the letters regarding this conference, as well as propositions and other details concerning safety apparatus, be sent to my address. M. STARKMANN.

Münchenerstr. 14,
Berlin W., 30, Germany.

WHY THE TARRING OF ROADS IS INJURIOUS TO VEGETATION.

To the Editor of the SCIENTIFIC AMERICAN:

The interesting article by Fernand Honore in the SCIENTIFIC AMERICAN of August 27th has been called to my attention by a friend, and I should like to accept the invitation of its closing paragraph.

It has been known for a long time that the vapor given off by hot tar is poisonous to plants. Statements to this effect have appeared from time to time as the expression of the unfortunate experiences especially of greenhouse men. Walls, wood-work, etc., about greenhouses are often treated with melted tar as a waterproofing material; and when the tar is heated in open kettles out of doors, near growing plants, these plants very quickly show the effects. The leaves become spotted, and a thorough smoking results in the death and fall of the leaves and may even cost the life of the more sensitive plants in the immediate vicinity of the melting-pot. Once the tar is cooled on the wood or stone or other work of the greenhouse it is harmless; but while it is hot it is poisonous, and tar-paints should never be used for steam pipes or hot-water pipes for this reason.

Mr. Honoré's article, entitled "The Effect of Tarred Roads Upon Trees and Shrubs," is a little misleading, as one may infer from the above; for it is not the *tarred road* which produced the injuries described, but rather the incautious way in which the tar was heated This resulted in exposing the trees, shrubs, and herbaceous plants to the vapors of tar. Except for cutting off the water supply and for producing the associated unnatural conditions in the soil, tar on a road does no harm to the plants growing beside it. In this respect tar is much better than some of the oils commonly used as binders on the roads in various parts of this country, for these oils may travel by capillarity and otherwise for considerable distances through the soil bordering a road and produce considerable damage.

If your readers care for a fuller discussion of this question, they will find one in Haselhoff and Lindau's "Die Beschädigung der Vegetation durch Rauch," Leipzig, 1903. There are other German references, but none in English which I can give. I shall be glad however to supply any information that I may be able to if any is desired. GEORGE J. PEIRCE.

Stanford University, Cal. Professor of Botany.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1820, is from the pen of Mr. H. A. Crafts, and is entitled "The Problem of the Sacramento River." The Sacramento valley contains not less than 13,000,000 acres of rich, arable land, with ample water to irrigate the whole of it. If the valley were irrigated and cultivated to its full capacity, it would be able to support a population of 5,000,000. This same Sacramento River in its present state is a handicap and a constant menace, because of the weakness of its banks. All the engineering problems involved are ably discussed by Mr. Crafts.—Under the title, "Some Simple New Inventions" are described a few ingenious devices which have recently made their appearance abroad, and which are of great practical utility. Directions are given for the treatment of objects before bronzing, and for the bronzing process itself.—Mr. Harold J. Shepstone describes some "Powerful Light Motors for Aeroplanes."—Of all kinds of treasure hunting, perhaps that of raising treasures from sunken ships is the most romantic. This phase of the subject is discussed in an illustrated article.—The results accruing from the observations of Mars during the opposition of 1909 are reviewed by Mr. W. E. Rolston.—Mr. Grover Cleveland Loening publishes the fifth instalment of his paper, "Practice and Theory of Aviation," in which he compares successful aeroplane types, their mounting, rudders, keels, transverse control, aspect ratio, incident angle, propellers, and efficiency.—Dr. Crouzon writes on the "Physiological Effects of Altitude," a subject which has been of interest ever since the balloon was invented.—The usual Science Notes, Engineering Notes, and Trade Notes and Formulæ will be found.

Magnetic and Electric Properties of Alloys of Iron and Copper.

Burgess and Aston have examined the electrical and magnetic properties of a series of alloys of iron and copper, containing from 0.09 and 7.05 per cent of copper, and also of an alloy containing 94.3 per cent of copper. The magnetic properties were studied by means of Esterline's permeameter. Each alloy was examined in four different conditions: fused, cooled slowly from a temperature of 1250 deg. F., cooled slowly from 1800 deg. F., and quickly cooled or chilled from 1650 deg. F.

The results show that the magnetic permeability falls rapidly with increase in percentage of copper. When the proportion of copper is less than 4 per cent, the permeability differs little from that of electrolytic iron. The alloy containing 94.3 per cent of copper was found destitute of magnetic properties. With proportions of copper between 1 and 2 per cent, the properties are similar to those of iron nickel alloys, containing from 2 to 7 per cent of nickel when the alloy is slowly cooled from 1250 deg. F. This treatment retains all the magnetic properties and improves the mechanical strength.

The electrical resistance was found to vary in a manner which could not be expressed by a smooth curve, as is indicated in the following table:

Percentage of copper.	Relative resistance.
0.09	1.01
0.2	0.99
0.8	1.12
1.01	1.22
1.51	1.41
2.01	1.11
3.99	1.05
5.07	1.03
7.05	1.31
94.3	0.24

The New Test for Blood Stains.

Everyone who has read the account of a recent trial for murder must have been struck by the report of the evidence that certain stains had been proved to be human blood by a "new serum test."

This test, now used for the first time in an English criminal case, is an application of one of the most remarkable discoveries in physiological chemistry. It depends upon the discovery that the serum from a rabbit or mouse into which human serum had been injected gave a precipitate with the serum of human blood, but not with that from the blood of animals.

Even blood stains several months old, when dissolved in a dilute solution of sodium chloride, gave the reaction, though a stain nine years old failed to react.

The first occasion upon which this test was employed in criminal work was in a trial that took place in France some five years ago. The prisoner had stated that a blood stain had been caused by the blood of a rabbit. A serum specific for rabbit's blood-serum was therefore prepared, and when this gave no precipitate within thirty minutes with an extract from the stain it could be stated with certainty that no rabbit's blood was present.

Proper Type of Irrigation Systems.

Irrigation with surface water requires large co-operative projects, but the problem of irrigating with ground water, even on a large scale, is essentially different. In Estancia Valley, according to Mr. Meinzer, each farmer should develop his own supply, install his own pumping plant, and construct his own reservoirs and system of distribution. This method of development will insure a maximum supply with a minimum lowering of the head and will involve the least lift and the least loss in distribution. The only respect in which co-operation may be found profitable will be in installing a central power plant.

The McAdoo tube now extends to Thirty-third Street and Broadway, New York city. On November 3rd the first train was run through the tube. It traveled six miles through the lower tube, then up the Jersey side and back to New York by way of the upper tubes, in seventeen minutes, by no means the maximum speed possible. This was the first official trip. The next extension will carry the line to the Grand Central Station, which branch of the work will not be started until the coming spring, and will not be completed for at least two years.

RULES GOVERNING THE COMPETITION FOR THE $15,000 FLYING MACHINE PRIZE OFFERED BY MR. EDWIN GOULD.

1. A prize of $15,000 has been offered by Mr. Edwin Gould for the most perfect and practicable heavier-than-air flying machine, designed and demonstrated in this country, and equipped with two or more complete power plants (separate motors and propellers), so connected that any power plant may be operated independently, or that they may be used together.

CONDITIONS OF ENTRY.

2. Competitors for the prize must file with the Contest Committee complete drawings and specifications of their machines, in which the arrangement of the engines and propellers is clearly shown, with the mechanism for throwing into or out of gear one or all of the engines and propellers. Such entry should be addressed to the Contest Committee of the GOULD-SCIENTIFIC AMERICAN Prize, 361 Broadway, New York city. Each contestant, in formally entering his machine, must specify its type (monoplane, biplane, helicopter, etc.), give its principal dimensions, the number and sizes of its motors and propellers, its horsepower, fuel-carrying capacity, and the nature of its steering and controlling devices.

3. Entries must be received at the office of the SCIENTIFIC AMERICAN on or before June 1st, 1911. Contests will take place July 4th, 1911, and following days. At least two machines must be entered in the contest or the prize will not be awarded.

CONTEST COMMITTEE.

4. The committee will consist of a representative of the SCIENTIFIC AMERICAN, a representative of the Aero Club of America, and the representative of some technical institute. This committee shall pass upon the practicability and efficiency of all the machines entered in competition, and they shall also act as judges in determining which machine has made the best flights and complied with the tests upon which the winning of the prize is conditional. The decision of this committee shall be final.

CONDITIONS OF THE TEST.

5. Before making a flight each contestant or his agent must prove to the satisfaction of the Contest Committee that he is able to drive each engine and propeller independently of the other or others, and that he is able to couple up all engines and propellers and drive them in unison. No machine will be allowed to compete unless it can fulfill these requirements to the satisfaction of the Contest Committee. The prize shall not be awarded unless the competitor can demonstrate that he is able to drive his machine in a continuous flight, over a designated course; and for a period of at least one hour he must run with one of his power plants disconnected; also he must drive his engines during said flight alternately and together. Recording tachometers attached to the motors can probably be used to prove such performance.

In the judging of the performances of the various machines, the questions of stability, ease of control, and safety will also be taken into consideration by the judges. The machine best fulfilling these conditions shall be awarded the prize.

6. All heavier-than-air machines of any type whatever—aeroplanes, helicopters, ornithopters, etc.—shall be entitled to compete for the prize, but all machines carrying a balloon or gas-containing envelope for purposes of support are excluded from the competition.

7. The flights will be made under reasonable conditions of weather. The judges will, at their discretion, order the flights to begin at any time they may see fit, provided they consider the weather conditions sufficiently favorable.

8. No entry fee will be charged, but the contestant must pay for the transportation of his machine to and from the field of trial.

9. The place of holding the trial shall be determined by the Contest Committee, and the location of such place of trial shall be announced on or about June 1st, 1911.

Brig.-Gen. James Allen has recommended the acquisition of at least twenty aeroplanes in his annual report for the fiscal year ending June 30th last, which was recently made public by the War Department. Gen. Allen contends that his estimate is extremely low, and that it would provide for only two aeroplanes for each camp of instruction. To operate this number of machines, twenty trained officers would be required as pilots, and in addition, each machine must carry at least one observer, who would require much training and actual practice before the full military use of the aeroplane can be obtained.

WHAT ARE SUN-SPOTS?

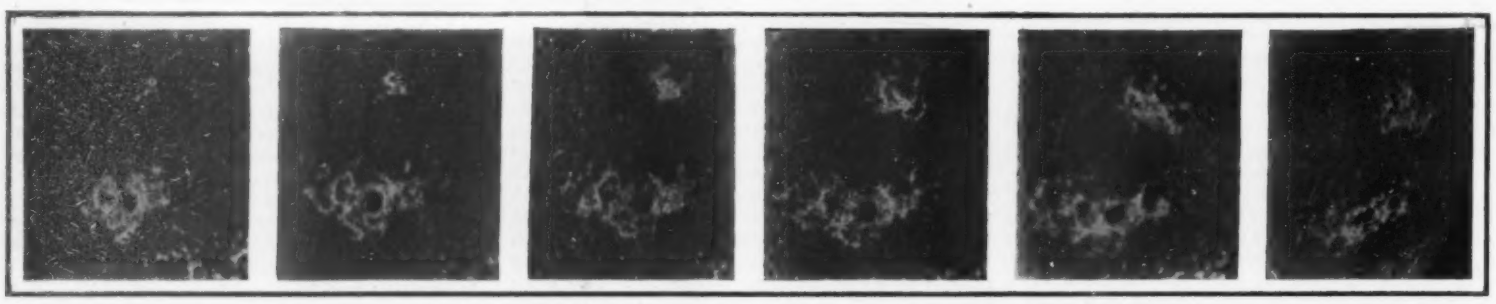
BY HERBERT T. WADE

ILLUSTRATED WITH PHOTOGRAPHS FROM THE YERKES OBSERVATORY

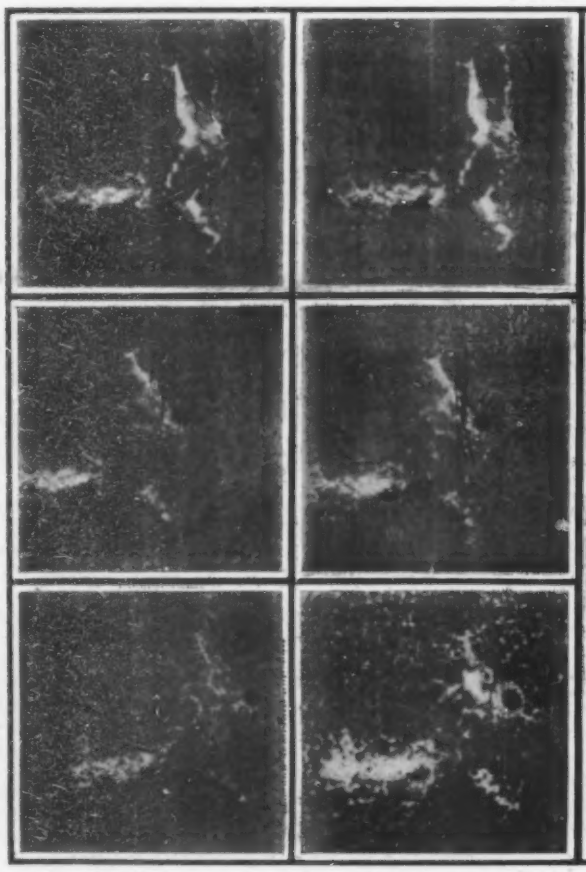
Our great brilliant sun, when considered in connection with the universe at large, is but a star, similar to many of the twinkling points of light in our heavens. Aside from its relation to the motion of the earth and the planets comprising the solar system, the sun is of special interest in any consideration of the larger problems of the constitution and ultimate nature of the universe. Instead of being placed at an all but infinite distance, as are the other stars, it is sufficiently near the earth to enable man to study it with great facility. With the spectroscope can be ascertained and determined the various chemical elements composing the sun and the other stars, and whatever these sun-spots might be, they were either attached to the sun and revolved with it around an axis, or were in very close proximity to its surface. He also discovered that the sun-spots were most abundant in two regions on either side of the sun's equator. In addition, he noticed the frequent appearance of groups of sun-spots, and it was apparent to him and other early observers that changes in the size and shape of the individual spots were in progress.

The spots as seen by Galileo, and reproduced by him in some excellent drawings, consist of a dark central part or "umbra," separated from which by a fairly sharp line of demarkation is a somewhat brighter part or dark fringe of filaments known as the "penumbra." As they have always been the most conspicuous phenomena of the sun aside from those witnessed only at times of eclipses, sun-spots have figured prominently in all speculations and theories as to the nature of the sun. In fact, for many years it was believed that they would furnish the most important clue to this problem; and while modern methods make other phenomena available for this purpose, the sun-spots still have a predominant significance. All this has been emphasized by recent work carried on by George E. Hale.

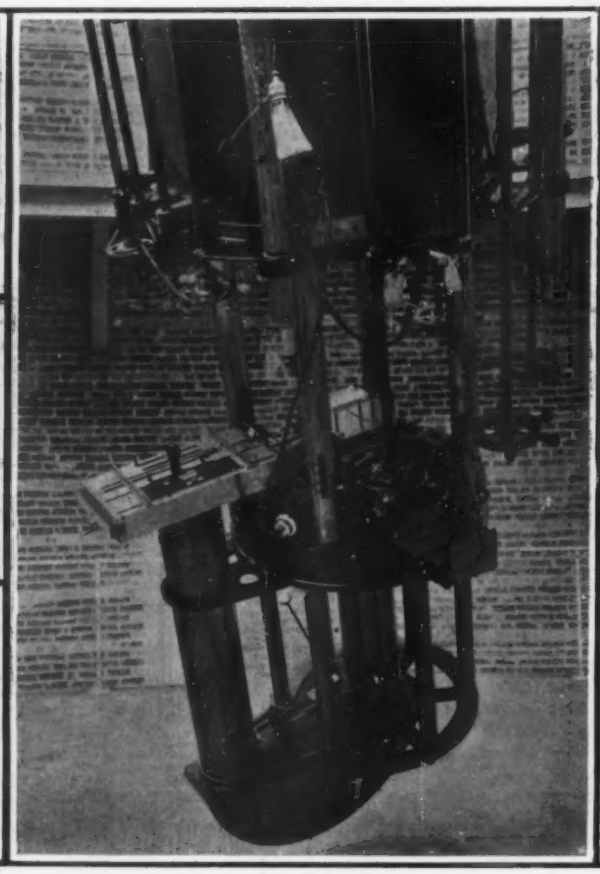
By the middle of the nineteenth century the time was ripe for solving some of the fundamental problems involved in the nature and composition of the sun. Despite the increased size and power of the telescope, it had revealed to astronomers but little more of the sun than was apparent to Galileo and his contemporaries. Through a large telescope the photosphere or surface shows a mottled appearance with cloud-like nodules which have been compared with rice grains. These in turn are composed of smaller granules, which are intensely luminous and are constantly and rapidly changing in their appearance with manifestations of the greatest activity. It is quite evident, as was noted by Galileo, that the sun-spots are also in constant motion, although there is a certain periodicity in their appearance and regularity in their movement. There is a limit to the amount of the sun's surface revealed by the telescope when used directly; but if we employ the instrument in connection with a spectroscope, our range is widely extended. With a modern high-power telescope we can obtain



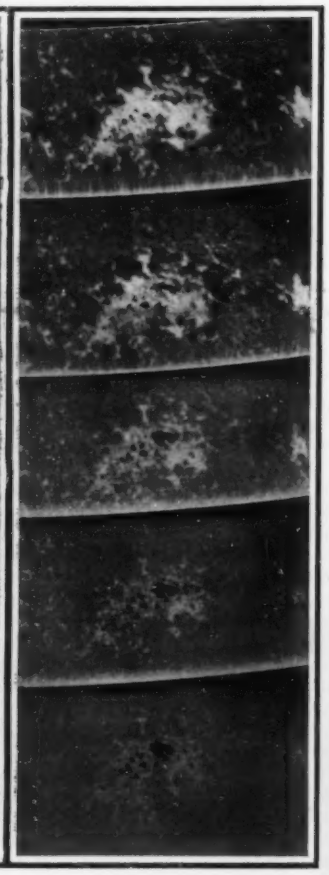
Spectroheliograms illustrating the development of a spot and the rotation of the sun. The photographs were made at Yerkes observatory from May 6th to May 13th, 1907.



Growth and subsidence of an eruption 140,000 miles long connecting two sun-spots. These six photographs were taken with Rumford spectroheliograph at the Yerkes observatory.



The Rumford spectroheliograph attached to the 40-inch Yerkes telescope. By means of the spectroheliograph the sun is photographed with light of any given wave length in the solar spectrum.



Five views of a sun-spot at different levels taken with spectroheliograph with slit at various distances from center of line.

from their colors and spectra astronomers and astrophysicists have hazarded shrewd and probable conjectures as to their relative ages and natures; while from their positions and motions, with further assistance from the spectroscope, their distances and masses have been respectively computed in millions of miles and of tons. It is but natural therefore that astronomers have appreciated always the importance of solar studies, not only for the light that they throw on the sun's nature, but also in the development of cosmical theory. Consequently, observations have been made of the sun from early times, but until comparatively recently without the successful results that have been attained in other departments of astronomy.

Chinese and other ancient observers early noted a mottled appearance of the sun's surface, and prior to the invention of the telescope, the dark spots were thought to be due to the passage of a planet such as Mercury in front of the sun. Galileo from his early telescopic observations demonstrated conclusively that an image sufficiently large, so that any portion such as a sun-spot or one of the faculæ (regions of intense brightness) can fall on the slit of the spectroscope, and the spectrum from that particular part can be studied.

With the advent of the spectroscope and its brilliant use in astronomical research by astronomers and physicists, various new and provisional theories of the origin and nature of the sun-spots were forthcoming, but may be here neglected in view of the positive results secured through an ingenious adaptation of the spectroscope known as the spectroheliograph.

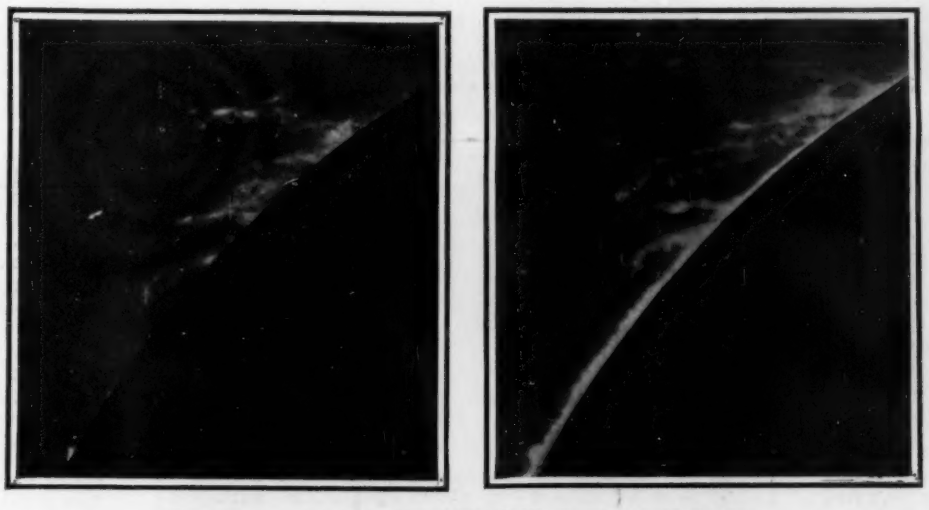
The spectroheliograph was devised by Prof. George E. Hale when at the Kenwood Observatory, Chicago, and is a modification of the spectroscope, or rather of the spectrograph, where a photographic plate replaces the eye of the observer and enables a permanent record to be made, including also certain colors to which the eye is not sensitive. With the spectroheliograph the sun may be photographed with the light from any single element, or more exactly with the light from any

one of the spectral lines from such an element. Because light is opaque to light of the same color or wave length, dark absorption lines are produced when light from the photosphere passes through the reversing layer or next outer layer of the sun's atmosphere, which consists of glowing gases somewhat cooler than the photosphere beneath. In certain cases the absorbing material is of great extent, so that while the reversing layer may make a broad dark line, there will be produced in its center a narrow bright line due to the double reversal. By arranging the spectroscope so that, while this line is produced, all the others are screened off, and then by moving the slit across the solar image formed by the telescope and at the same time moving the photographic plate on which the line of the spectrum falls in unison with the slit, it is evident that a photograph of the entire disk of the sun can be made in light of a single color, or speaking optically of a single wave length. This ingenious device was tried first on the solar prominences, using the *K* (violet) line of calcium, as that element is prominent in this part of the sun. Most satisfactory photographs were obtained, showing the clouds of hot calcium vapor above the reversing layer. In this way beautiful representations of the chromosphere, or layer of gases next above the reversing layer, and of the prominences, as well as of very conspicuous vaporous clouds of woolly appearance which have been named "flocculi."

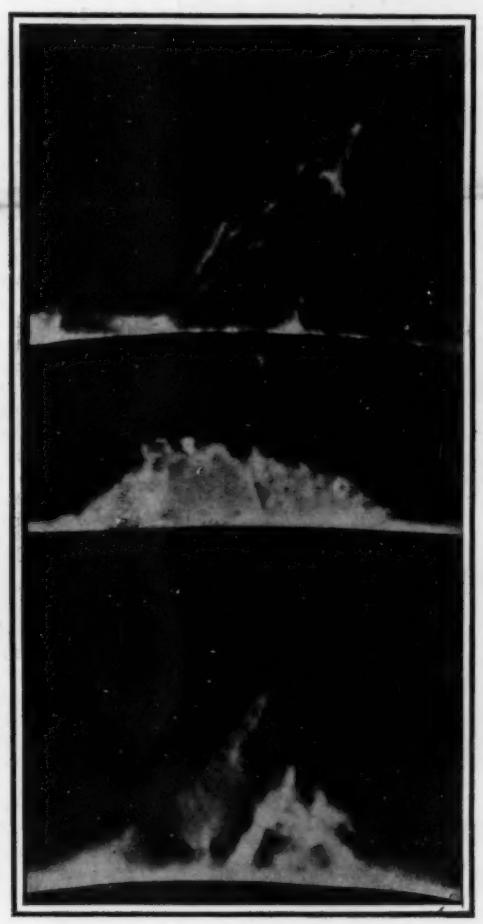
Prof. Hale's early success with the spectroheliograph led him to develop and improve this instrument both optically and mechanically, and he was able to make a series of new and important discoveries. He studied calcium vapor. Often this calcium vapor was shown in motion with various manifestations of activity, which ranged from sudden and violent eruptions from the sun's interior to quiet cloudlike appearances floating over its surface.

After success with the calcium lines in using the spectroheliograph, it was determined to employ similar distribution of iron filings around the poles of a magnet, and led to the conclusion that some unknown but definite force must be acting. This line of investigation received a further impetus when, by the development of sensitive plates for astronomical and spectral photography, it was found feasible to use the red line of hydrogen. This made possible the photographing of flocculi at even greater atmospheric heights, and clearer representations of the prominences were secured. In the photographs of the flocculi thus obtained sharp and strong contrast was secured, where evidences of definite structure and clearly defined stream lines were revealed. The most striking feature of these red-line hydrogen photographs was the appearance of cyclonic storms or vortices in the neighborhood of sun-spots, evidently associated either with single spots or groups of spots. There was every evidence of their rotary motion and their attraction on the surrounding gases. This was shown particularly when photographs were made of the same spot after brief intervals. Here indeed was a fertile field for both speculation and further research. Daily photographs revealed the growth and sudden appearance of these cyclonic storms, the magnitude of which readily could be appreciated.

There was every evidence of intense and often sudden activity in the gases composing the solar atmosphere. Their connection

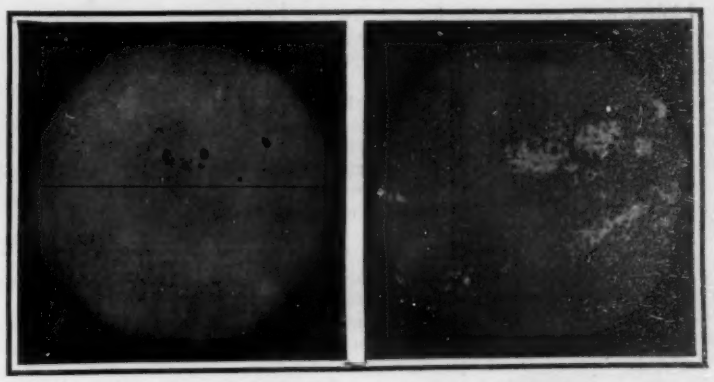


Eruptive prominence on May 18th, 1907, showing rapid changes.



To the left is a photograph of the west limb, showing prominences observed on November 3rd, 1904. To the right are enlargements of these prominences.

The great sun-spot of July 17th, 1905, photographed with the 40-inch Yerkes refractor.



The sun's disk—a direct photograph and a high-level spectroheliogram compared, showing the amount of detail revealed by the spectroheliograph.

WHAT ARE SUN-SPOTS?

the surface of the sun itself, were secured. Once it was possible to secure a photographic record of prominences only at the time of an eclipse. Now the phenomenon can be registered at almost any time.

Not only is the *K* line of the calcium spectrum available, but also the *H* lines. The photographs thus made show a wealth of fine detail far greater than any observations either visual or photographic can reveal. The entire surface of the sun is shown to be covered with minute clouds of calcium vapor, while the faculæ which are so prominent near the sun's limb or edge, when studied carefully, present many new and interesting features, chief of which are the larly the green-blue, blue, and violet lines of hydrogen, not only for spectroscopic reasons, but for the active presence and importance of this gas in the chromosphere and prominences. Flocculi of hydrogen somewhat resembling those of calcium were likewise detected, but with the striking difference that the former generally were dark, though in regions near active sun-spots the hydrogen flocculi were bright, a difference which was assigned to differences in temperature in different regions. Furthermore, they were unlike the cumulus clouds of terrestrial regions, which the calcium flocculi resembled, but showed a certain definiteness of structure, which in many cases suggested the with sun-spots was unmistakable, but some explanation was required. This was suggested by the resemblance of the vortices in the photographs to the arrangement of the iron filings in the magnetic field, to which reference already has been made. It had been shown by the late Prof. Rowland of the Johns Hopkins University, that if an electrified body be revolved rapidly, a magnetic field would be produced, or in other words iron filings would be acted upon just as if they were in the vicinity of a magnet or a coil of wire through which an electric current was passing. According to this theory, if a sufficient num-

(*Continued on page 409.*)

THE NEW DOSNE HELIOGRAPH

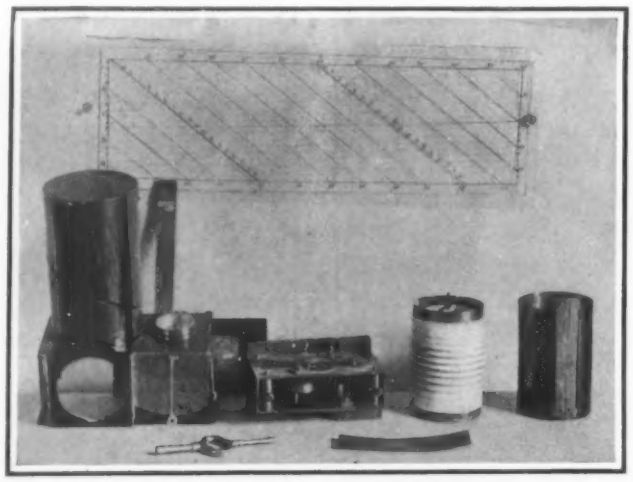
BY JACQUES BOYER

Most meteorologists and astronomers recognize a close connection between the activity of the sun and the principal phenomena of terrestrial physics. The nature of this connection is still unknown and, in order to discover it, every effort is made to obtain photographic and spectrographic records of all the changes that take place on the sun's surface. New instruments are continually being invented for this purpose. Eiffel's photoheliograph was recently described in the SCIENTIFIC AMERICAN.

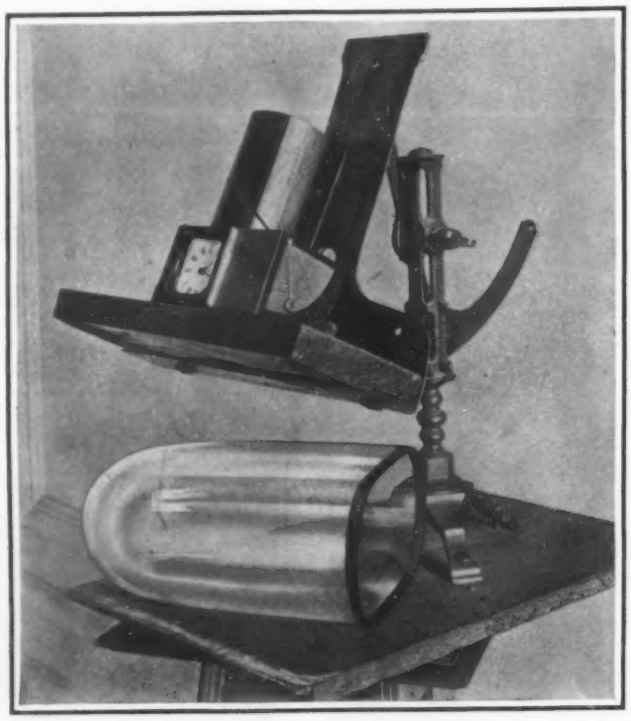
In a new photographic heliograph, invented by M. Dosne, a cylinder, two inches in diameter, is inclosed in a slightly larger coaxial hollow cylinder and both are turned by clockwork, so that the inner cylinder performs one revolution per hour, while the outer cylinder makes one revolution in 24 hours. The inner cylinder is covered with photographic paper and the outer cylinder has a longitudinal opening bordered by slides in which strips of brass, having longitudinal slits of various widths, can be inserted. The instrument is set up with the common axis of the cylinders in the meridian plane and perpendicular to the plane of the sun's declination. The outer cylinder is set with its slit in the plane which passes through the axis and the center of the sun, and the rotation of the outer cylinder keeps the slit in this continually shifting plane. The two cylinders are inclosed in a cylindrical metal case, in which is cut an oblique, a helicoidal, slit, about 1/12 inch wide. Hence, at any instant, the sun's rays strike only a small area of the photographic paper opposite the intersection of the oblique slit in the case and the fine longitudinal slit in the rotating hollow cylinder. As the hollow cylinder rotates this intersection moves along the helix, and the more rapid rotation of the inner cylinder, which carries the photographic paper, causes the blackened spot to describe a helix of shorter pitch, which makes one turn round the inner cylinder for each revolution, or each hour. Thus a continuous record of the photographic intensity of the sun's rays is produced by the variations in intensity from point to point of a continuous helicoidal line traced on the paper. The time corresponding to each point of the curve is obtained by means of a noon mark on the slit of the case and a transparent scale applied to the paper. Even rapid and small fluctuations of the solar intensity are clearly recorded, for a single hour corresponds to about 8 inches of the curve, and this rapid motion permits the employment of very sensitive paper, which registers the effect of diffuse daylight.

It is worthy of note that a loosely geared clockwork is preferable to a finely made mechanism, as it produces an intermittent movement of the cylinder and a brief exposure, with the paper at rest, after each advance.

Photographic diagrams produced in this way are more easily read and interpreted than those which are made by continuous movement. The accessory parts of the apparatus include a magnetic compass, a sun dial, a clocker, and two plummets. One of these plummets is suspended in front of a vertical sector, which is attached to the instrument and bears, in addition to a scale of degrees, marks which indicate the inclination to be given to the axis for each month of the year, according to the varying declination of the sun and the latitude of the place of observation. The instrument is also provided with marks which indicate the azimuth of the sun, when rising and setting, for each month of the year, so that the dimensions of the sheet of sensitive paper required can be easily determined. In short, the Dosne heliograph provides a simple method of registering the intensity of solar radiation and its variation according to the hour and the season. Unfortunately, it does not furnish a complete solution of this complex problem. Like other instruments of its class, it gives information chiefly concerning the violet and ultra-violet rays, which strongly affect the compounds of silver.



THE DOSNE HELIOGRAPH DISSECTED AND A RECORD MADE BY IT.



THE DOSNE HELIOGRAPH.

Cyrano and the Flying Machine.

The position which the works of Jules Verne hold in modern literature was occupied 250 years ago by the writings of Cyrano de Bergerac. The discovery of a hitherto unknown manuscript of Cyrano's cosmological novel in the State library of Munich, has recalled attention to the principles set forth by Cyrano in his novels "La Voyage de la Lune" (A Trip to the Moon) and "Les Empires du Soleil" (The Kingdom of the Sun). Cyrano, like Jules Verne, endeavored to solve a number of physical problems with the aid afforded by the science of his time. He was not able to confirm the correctness of his statements by calculation, and was obliged to leave many gaps which could not be bridged by contemporary technical science. Fundamentally, however, his writings are very similar to those of Jules Verne because they show how problems can be solved on assumed principles, whether these be sound natural laws, or mere superstitions. For example, Cyrano always assumes that living creatures exist on the sun and moon in conditions similar to those which prevail on earth, and he gives very minute descriptions of the apparatus by which a traveler can reach those heavenly bodies. He naturally pays no attention to the character of interplanetary space beyond the confines of the earth's atmosphere, but tacitly assumes that his travelers are always surrounded by the same medium. He describes six aerial vehicles which served him on his fictitious journeys to the sun and moon. A few of the principles employed in the construction of these machines are actually used in modern aeronautics; others are impossible of application, because they are based either upon superstitious beliefs or upon defective knowledge of the laws of nature.

Let us consider those machines which are constructed, to some extent, on scientific principles. One of these is a very simple apparatus, consisting of two globes filled with smoke. These globes are fastened to the shoulders of a man, and are supposed to have sufficient ascensional force to sustain his weight. In this manner one of Cyrano's bold explorers reached the vicinity of the moon, and then casting off the globes fell to the surface of the satellite, while the globe, freed from his weight, rose higher and higher and became the constellation Libra (the balance). But the fall to the moon would have cost the aeronaut his life if he had not spread out his cloak and thus formed a parachute which, buoyed up by the wind, carried him slowly and safely to the moon's surface.

It appears almost incredible that the hot-air balloon was not invented until 130 years after the date of this writing. Notwithstanding the great vogue enjoyed by Cyrano's works, no man dared to attempt to put his theories into practice during this long interval, and when the first Montgolfier balloon actually rose in the air, it had been forgotten that Cyrano de Bergerac, more than a century earlier, had described a flight to the moon made with a similar apparatus.

The vehicle employed in a journey to the sun is founded on the same principle, but in this case the air is heated by the sun's rays. The aeronaut sat in a rectangular box, from the top of which protruded an "ikosander," or mass of glass having twenty curved surfaces, by which the sun's rays were converged upon the air inside the box. The air, expanded by the concentrated solar rays, escaped from the top of the box, producing an indraft of cold air through orifices in the bottom of the box. The apparatus was so contrived, however, that the cold air could not enter as rapidly as the hot air escaped, and, consequently, an upward pressure was exerted, which increased as the vehicle approached the sun. Cyrano also imagines a steering device in the form of a sail, but his aeronaut is so surprised and delighted by his rapid ascent that the sheet falls from his hands.

The globes filled with smoke were clearly open to criticism, for every reader well knew from personal experience that smoke would not keep hot during so long a journey. For this reason, perhaps, Cyrano in his second apparatus called in the aid of the sun as a continuous source of heat. He was thus enabled to extend the duration of his fictitious journey to four months.

Another apparatus of more modern type came near costing the life of the inventor (in the story). This was a flying machine constructed on the model of a bird. Cyrano knew that a man's muscular strength would not suffice to operate this machine, having wings large enough to enable it to rise rapidly, instead of merely floating in the air; hence he employed a spring as the source of power. The flight was made from a high mountain, and was a lamentable failure, "because I did not take proper precautions," Cyrano concludes laconically.

The idea of replacing human power by machinery is so modern that even this crude conception of Cyrano's appears surprising. It is only within the present century that his idea has been put into practice. Powerful motors have been substituted for the simple spring, but the fundamental principle already existed in the brain of this imaginative Gascon, who doubtless regarded it as entirely fantastic and impracticable.

The three forms of apparatus described above have since been developed to practical usefulness, because they were based upon scientific principles. In the balloon, hot air was soon discarded for coal gas and hydrogen, which have more buoyancy and retain their efficiency for a longer time. The solution of the problem of flight by means of wings is an achievement of our own time. Not less interesting are some other machines which Cyrano designed for his fictitious journey to the moon. Some of these are constructed upon the crude and inexact principles of science in its infancy, and others are purely fantastic. Let us follow the story of the wrecked flying machine, which Cyrano abandons in order to cure his aching limbs. The wreck was discovered by soldiers, who attempted to send it up again by means of rockets, for the purpose of terrifying the hostile Indians. (The disaster is supposed to have occurred in America.)

Cyrano, according to the story, returned to the spot just as the fuse was lighted. He laid hands

(*Continued on page 410.*)

AUTOMOBILE ICE-SLED

BY FREDERICK E. LORD.

Ice yachting as a sport has long been popular in many countries. Much enjoyment is derived from a spin on fine, hard ice in a good breeze. There are localities, however, where the use of an ice yacht is limited either by lack of wind or insufficient width of suitable ice in which to work the boats. Many winter days are calm and bright, with good ice on bay and river; but the ice yachter must stay ashore, for he cannot sail without wind.

Once again the modern gas engine steps in to help out. If the yachtsman cannot sail, why not motor? With a well-designed motor sled and enough power he can spin over the ice at almost unlimited speed. Besides the pleasure of it he can also make such a boat very useful as a means of transportation. Where persons live along a lake or river and several miles away from the town they can step into their marine auto, fly to town in a few minutes, and shop or get the mail. Such a craft would run on a creek ten feet wide where, of course, the ice yacht is impossible. Such a motor-driven sled as shown can be built cheaply, the main cost being in the motor. This can be of high or low power, according to the speed desired.

The engine shown in the accompanying plans is a fairly high speed, two-cycle one, developing about 7 horse-power at eight hundred revolutions per minute. Such an engine can be bought for a reasonable sum and should drive the boat thirty miles an hour. If a lightweight, high-speed motor of twenty horse-power is installed, a speed of sixty miles per hour can be obtained.

The design shows a water-cooled motor as more easy to obtain in the right size, but an air-cooled one would be suitable. The size and radiating surface of the water tank would probably have to be determined by the particular motor used, but a flat tank shaped as indicated and containing about three gallons should work fairly well. If the water gets too hot it may be cooled by using a soft copper tube for the outlet pipe coiling it in a sort of spiral to give large radiating surface.

The first step in constructing the motor sled is to get out the frame and runner plank. The frame is composed of two spruce beams, each 9 feet 8 inches long, 4 inches deep, 2 inches thick forward and 1⅝ inches at the rudder end. The runner plank is also of spruce, 4½ feet long, 8 inches wide and 1¾ inches thick. Next cut out the piece which goes across the frame just behind the wheel box cover. This is of oak, 1¼ inches thick and 8 inches deep. The frame is now ready to be put together. Proceed by first bolting the two frame pieces to the runner plank with ½-inch bolts, two in each frame. The outside edges of the frames are 3 feet apart. Slip in a temporary cross brace about 3 feet aft of the runner plank and proceed to bend the frame sides. To do this wind a piece of rope around the end and gradually haul together. When the distance is about right place the oak piece back of the wheel box in a vertical position with its lower edge 1¾ inches below the under side of the frame. Bring the ends of the frame within 3 inches of each other and then fit in the block to take the rudder post. This should be of 3 or 4-inch spruce. After it has been properly fitted draw up the frame to it tightly and bolt clear through with three ½-inch bolts. It would be well to put in some 4-inch wire nails, as this end should be well fastened together in order to keep the frame stiff. The cross beams to support the motor foundation and drive wheel is then put in. This is a piece of oak or yellow pine 3 inches thick by 3½ inches in width. Its forward edge is placed 13 inches from the after edge

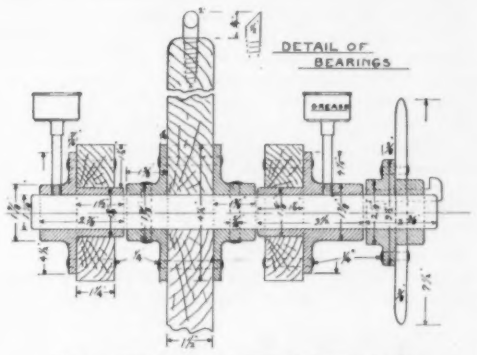


Fig. 4.—BEARINGS OF THE DRIVER SHAFT.

of the runner plank and is let into the frame sides about ¾ inch and secured thereto with ½-inch bolts. The engine beds are of 1¼-inch oak shaped as per plan and spaced according to the motor used. The frame is bolted to runner plank and cross beam with ½-inch bolts. The motor should be set off the center enough to allow the sprocket wheel to line with the one on the driving wheel.

The floor and seat had better be completed now. The floor is of ⅞-inch white pine laid in three strips 7 inches wide. Nail this to the frame and then under it nail 1¼ by 1¼-inch oak cleats and rivet them clear through to the top of the frame sides, as shown by the dotted lines in Fig. 1. This will prevent any possibility of the floor's letting down when any one is standing on it.

The seat back and sides are of ⅞-inch pine and placed and shaped as shown. An opening is cut out on the forward ends of the sides to serve as a hand rail. It is best to make the runners next. The forward runners are of 1¼-inch oak 4 feet long and 5 inches deep, including iron shoe which is 1¼ inches. This shoe is of soft iron shaped on the bottom to an angle of 30 degrees and fastened to the wood with five ½-inch bolts screwed in as shown at Fig. 3. The king pin, a ¾-inch bolt, should be placed 2 feet 7 inches from the point of the shoe and 1½ inches below the upper edge.

The bearing on the ice should be 1 feet 9 inches forward and 14 inches aft of the king pin, and care should be taken to get this correct. This bearing surface length is now given a curve or rocker of about ⅛ inch and the runner is completed. The steering runner is 3 feet long and 4½ inches high, including the runner, and is made just like the two forward ones. A 1-inch shoe is deep enough for it, and the king pin is 1 foot 11 inches from the runner tip and 2 inches below the upper edge.

The two forward runners are now attached to the runner plank. This is accomplished by bolting cheek blocks of 1¼-inch oak 3 inches deep and 14 inches long to both sides of the runners with ½-inch bolts, and then putting in the king pins, which are ⅝-inch bolts.

The runners are spaced 3 feet 9 inches apart, and great care should be taken to get them exactly parallel to themselves and to the center axis of the frame. To do this drive a nail in the center of the frame at the rudder and mark the center of the runner plank. Attach a string to the nail and stretch forward over the pencil mark on the center of the runner plank. Nail on the cheek blocks at one end with runners between. Then swing them until each end of the runners is equally distant from the string on the center line. Nail the other ends of cheek blocks to hold them temporarily and then put in the ½-inch bolts and king pins.

A simple method of making the rudder post, etc., is to get a bronze casting for the yoke that takes the king pin and then bore an inch hole in the upper end. Into this slip the rudder post, of 1-inch iron and 10 inches long, and pin it with a ⅝-inch iron pin.

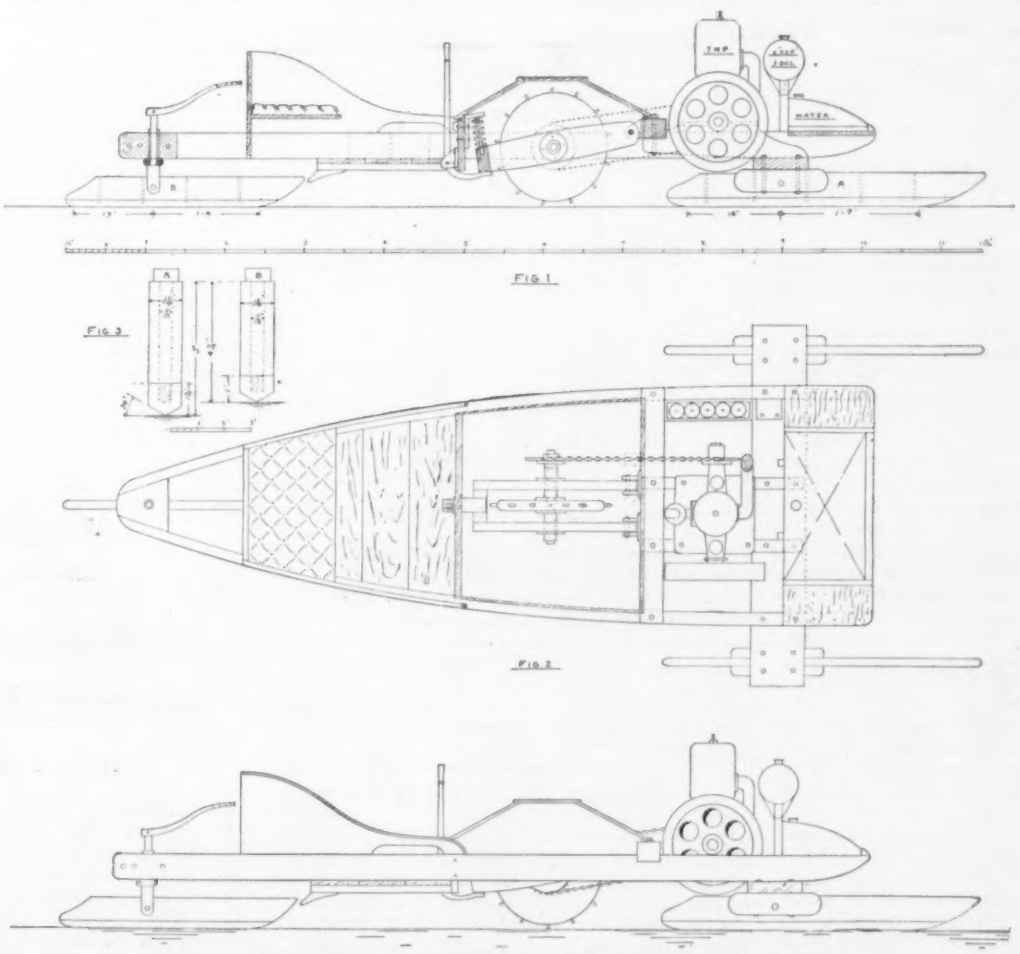
A blacksmith will forge a tiller for a small sum and fit the whole thing together. Put in a piece of brass tubing into the wood of the frame, just large enough to allow play for the post. A rubber ring 3 inches in diameter and 1¼ inches thick and fitted with two 3-inch iron washers, should be slipped over the post just under the frame, to absorb the jar and shock of the runner, as it pounds over the rough places on the ice.

This completes the framework and running gear and the next and final step is to put in the driving wheel and install the motor and its accessories.

The driving wheel is made out of a single piece of hard white oak 1½ inches thick and 16 inches in diameter. The driving teeth, thirteen in number, can be made of ½-inch iron lag screws about 4 inches long. Bore holes in the rim of about 1/16 inch less diameter than the lags and screw them in. Then cut their heads off with a hack saw and file them to a chisel edge with a bevel of about 45 deg., as illustrated at the top of Fig. 4.

The side pieces that carry the wheel should be of 1¼-inch oak about 4½ inches wide at the center and 3 inches at the ends. An oak block 2 inches thick and 3 inches deep is fitted at the after end and fastened to the side pieces with two ⅝-inch iron rivets. For the flanges and bearings of the wheel and yoke it is best to make a pattern and have bronze castings made which can then be turned up on a lathe. This expense would be small and would insure a good job where it is certainly needed. Rivet the two flanges on the driving wheel together through the wood and treat the yoke flanges in the same way. Fig. 4 shows the dimensions and method of fastening. The driving shaft is a piece of 1½-inch steel about 14 inches long. The forward end of the wheel yoke is secured to the oak cross beam by two brass cast lugs with ⅝-inch pins passing through them and the yoke ends. It is necessary to place the centers of the driving wheel, yoke pins and engine shaft in a straight line in order to prevent the pull of the chain from raising the wheel off the ice.

A piece of flat iron ½ inch thick and 2 inches wide is bent over and fastened to the oak cross board behind



Figs. 1 to 3.—SECTION, PLAN, AND SIDE VIEWS OF THE AUTOMOBILE ICE SLED.

the driving wheel to take the thrust of the spring. This spring should be about 1¾ inches in diameter and 4½ inches long and should have a compression strength of about 150 pounds per inch. Two iron studs are fitted, as shown, to keep it from falling out. An iron lever forged out as illustrated and held by a brass lug with a ½-inch pin is used to raise the driving wheel off the ice, when starting the motor. It is necessary to have a spring arrangement as shown because if a rigid system were used the wheel or yoke would probably be wrecked if the driver should happen to hit a lump of ice projecting above the mean surface. To start, pull back the lever and slip in a small block of wood to hold it. When the motor is going remove the block and apply pressure on the ice by gently letting up on the lever, at the same time opening the throttle and advancing the spark. Build a cover over the wheel, of light pine, as shown, in order to keep out flying ice and afford protection from the mechanism.

The motor should now be installed, also the tanks and electric outfit. The water tank is mounted on a little platform as shown. It should be of light copper 12 inches wide and 22 inches long, 5 inches high at the back and tapering to ½ inch forward. The gasoline tank is a copper cylinder 6 inches in diameter and 20 inches long, mounted on two posts fitted with saddles and secured by straps of sheet copper.

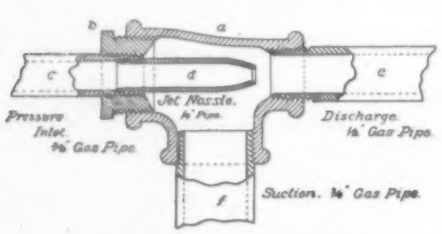
The spark coil may be hung on the side of the frame and the batteries likewise, as shown in Fig. 2.

Lead the exhaust down toward the ice so that the gases may pass under the sled. For the driving transmission use two sprockets about 8 inches in diameter with a ½-inch heavy motorcycle roller chain. The size of the sprockets will have to be determined by conditions, revolutions, and power of motor, etc.; but the dimensions given above should be about right for 7 horse-power at 800 revolutions; under which conditions the outfit ought to be doing something like thirty miles an hour. For paint, light gray or automobile red should present a neat finish.

WATER-JET PUMP FOR HOME USE.

BY H. B. DAILEY.

There are often occasions in home experience when a small self-acting pump of some sort for moving moderate quantities of waste water is of more than ordi-



WATER-JET PUMP FOR HOME USE.

nary utility, and there are few householders who have not at one time or another felt the need of such a device.

Perhaps the family rain cistern has become foul, and needs emptying of its remaining contents before it can be cleaned. A quantity of muddy water from our neighbor's lot on higher ground has found its way into our cellar during last night's storm, and we must wait patiently for its recession or resort to tedious hand bailing. The drain pool from the kitchen sink is full, but we dread the job of dipping it out by hand.

Then there are the laundry tubs to be emptied after washing is done; waste water from flushing the basement floor to be taken care of, and sundry other emergencies that present themselves when the advantages of regular sewer service are not to be enjoyed.

For such uses, where quantities of waste water are to be lifted a few feet, there is no form of self-acting pump so easily made and so cheaply operated as a water-jet pump, adapted to take its power from the house water-pressure service.

The illustration shows an efficient jet-pump made wholly of ordinary gas-pipe fittings. As its construction involves no machine work, the apparatus can be put together by the Handy Man in a few minutes' time.

The body of the pump, *a*, is a ¾ x ½ x ¾-inch gas tee, the larger end opening of which is closed by a ¾ x ⅜-inch gas bushing, *b*, into whose central aperture is screwed the pressure inlet tube, *c*, of ⅜-inch gas-pipe. The inner end of *c* is tapped out to receive the jet-nozzle, *d*, of ¼-inch gas-pipe. The smaller end opening of the body receives the discharge tube, *e*, of ½-inch gas-pipe, whose length, to insure proper working, should be about 12 inches.

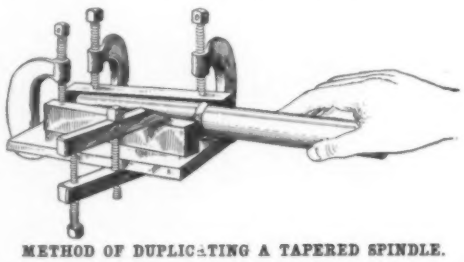
The jet nozzle, whose aperture is 7/32 of an inch, is of such a length that its end reaches to within ¼ of an inch of the inner end of the discharge pipe. In forming the nozzle, it is first cut to the right length and screwed into the pressure inlet pipe, which can be then used as a handle for holding the nozzle while its end is being pointed down in the blacksmith's fire to form the jet opening. The side opening of the tee receives the suction tube *f* of ¾-inch gas-pipe.

To use the appliance, it is only necessary to connect the pressure inlet with the house water service and turn on the water. When the suction tube (which may terminate in a flexible rubber hose if desired) is dropped into a pool or tub of water, the water rises through *f* to fill the vacuum formed in the body of the pump by the rush of the jet through the discharge tube. The waste water mingling with that from the jet is carried forward and rapidly ejected.

The action of the pump is quite rapid and satisfactory, and experiments with it have shown that when the lift does not exceed six or eight feet, the quantity of water handled is considerably in excess of that required to run it. The pump should be used in a horizontal position, and the discharge should be allowed to empty freely into a funnel or sink.

METHOD OF DUPLICATING A TAPERED SPINDLE.

Mr. Charles Way, an expert mechanic, received a spindle without any centers and was asked to make a duplicate absolutely like the pattern. Using calipers was out of the question for accurate work on a



METHOD OF DUPLICATING A TAPERED SPINDLE.

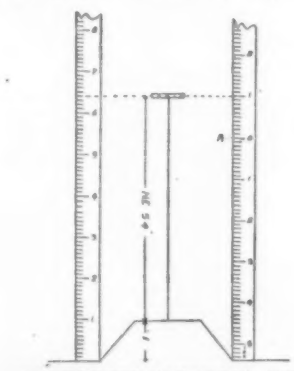
taper; and having no socket to go by or centers in the pattern spindle, he devised a tapering gage by clamping parallel bars on a level bed piece. It can readily be seen that this is the best and surest way of doing the work. It is even better than having the socket, as one can examine the entire length of taper and note where any metal must be taken off.

SELF-READING BACK-LEVEL ROD.

When using an ordinary level rod in back-level work, the fact that H. E. (height of eye) has to be taken into consideration for every reading often leads to error.

While the rod described below can only be used by persons having the same height of eye, still its cheapness and simplicity will more than offset this.

Take a straight, well-seasoned piece of pine having



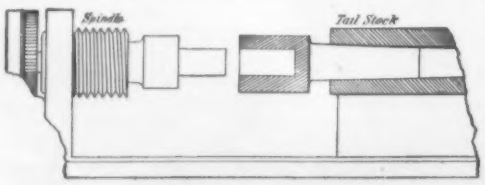
SELF-READING BACK-LEVEL ROD.

a cross-section about ⅞ inch x 3 inches and of any convenient length, usually about 7 feet or 8 feet, and mark on it the H. E. as *A* in the diagram. Then divide it up and down as shown. It can easily be seen from the diagram how the rod is read. Instead of reading 6.4 feet, as with an ordinary rod, and subtracting the H. E., say 5.4 feet, to get the difference in elevation, the levelman reads 1 foot direct, which greatly simplifies the work. The rod reads direct going up or down grade.

HOW TO LINE UP THE CENTERS IN A LATHE.

BY H. D. CHAPMAN.

The accompanying drawing shows the way in which the tail stock of a lathe can be easily put in line with the spindle of the lathe. There are some lathes that do not have the taper attachment, and when sliding the tail stock out of line in order to cut the required taper it is a hard job to get the tail stock back in



PLUG FOR LINING UP LATHE CENTERS.

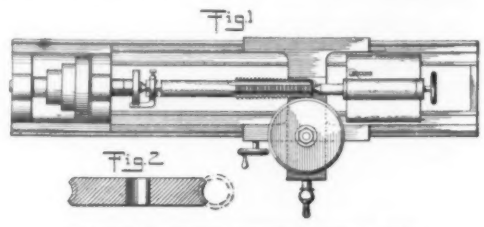
line with the spindle of the lathe. The line cut shows the way in which this can be done very successfully and quickly.

Male and female plug centers are made. These centers are made of tool steel hardened and ground to suit the taper in the spindle and the tail stock of the lathe. When the centers are to be lined up the plug centers are placed in position as shown. The centers are adjusted until the plug center will slip in the ring center of the tail stock. The centers are to be ground to a neat sliding fit; and when the tail stock has been adjusted to receive the center in the spindle, one can be sure the lathe centers line.

CUTTING A WORM WHEEL WITH A TAP.

BY J. A. BERSTROM.

The accompanying illustrations show how a worm wheel may be cut in an ordinary lathe without any gear-cutting attachment. It is only necessary to have an ordinary tap of the thread desired. The worm of course will be an ordinary screw with the same pitch as the tap. The blank of the wheel is made as shown in Fig. 2, and is mounted to revolve on a stud fastened to the tool post of the carriage. The



CUTTING A WORM WHEEL WITH A TAP.

tap is put between the centers of the lathe and made to revolve with the spindle by means of the usual lathe dog.

It is best to use a taper tap, although any of the taps will do. If the taper tap is used it is only necessary to set the tool carriage with the blank at the right-hand end of the tap as shown in Fig. 1, which is a plan view of a lathe ready to cut the wheel. The tap will just touch the blank, and as the tap revolves and begins to cut into the blank the latter will also revolve. The carriage is fed very slowly to the left, giving the tap ample time to cut the whole circumference of the wheel before the next move. It will now be seen that when the blank has been moved far enough to the left for the whole thread of the tap to be cutting, the wheel is finished.

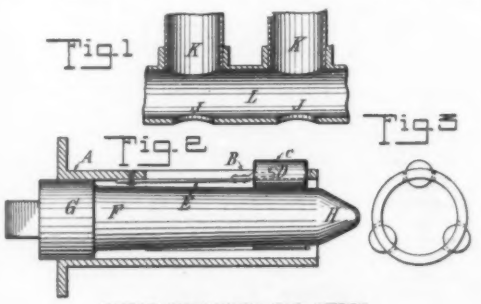
For ordinary small threads it is not necessary to make the diameter any given size, as the thread of the tap will rectify it to the diameter, that is, it will always cut a fine thread by moving the blank closer to the center of the lathe.

INGENIOUS TUBE EXPANDER.

BY W. J. C.

A novel shop kink came under my observation some time ago by which some tubes were expanded in a header, where the only means of access to them was through a hole smaller than the tube itself. In Fig. 1 *L* represents the header and *K* the tubes, *J* being the hole left for cleaning out, afterward to be plugged up.

A tube *A*, Fig. 2, with a flange on one end, was



NOVEL EXPANDER FOR TUBES.

turned just small enough to enter *J*, and in the end of it were cut three slots *B*. In these slots the expanding rollers *C* fitted. They were supported on small pins *D*, on which they turned freely, the latter being riveted to a flat spring *E*, which was in turn fastened to *A*. The tendency of the springs was to bring the rollers into the center of the tube. The taper pin *F*, pointed at one end *H*, in order to press the rollers apart, had a parallel portion *G*, which acted as a guide. The flanges on the tube *A* also acted as a guide by being kept hard up against the header *L*. By the use of this tool both ends of the tube were expanded, and the use of right and left-hand threads obviated. On the taper pin *F* being withdrawn, the springs brought the rollers within the outer wall of the tube *A*, and permitted the entire apparatus to be taken out through the small hole *J*.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

STRAIN-INSULATOR.—L. STEINBERGER, New York, N. Y. In this case the invention relates to strain insulators admitting of general use and also of various special uses in connection with wireless towers, commercial cables, and in practically all relations where great insulating strength is to be combined with great mechanical strength.

CABLE-HANGER.—E. G. JEFFRIES, Boise, Idaho. A simple device for suspending electrical cable wires from a supporting cable is illustrated herewith. The device consists of a strap that passes under the electrical cable, and is connected to an angle lever formed of

CABLE-HANGER.

wire. One arm of this lever is bent to the form of a yoke, so that it will fit over the top of the supporting cable when the other arm is moved downward. The angle lever serves to draw the electrical cable snugly up against the supporting cable and hold it in this position.

Of Interest to Farmers.

ADJUSTABLE PLOW-POINT.—N. L. OLSON, Butte, Mont. This is an improvement in plows and provides a novel construction of plow point together with means whereby the same may be supported in such manner that it can be adjusted both laterally and up and down at its point in order to regulate the depth of the furrow as well as the pointing of "inland."

INCUBATOR-ALARM.—W. M. BRALY, Blackwell, Okla. The object here is to provide an alarm with a bar having an uneven surface, which is connected with the damper lever of the incubator, and is adapted to be operated thereby, there being a lever which is pressed against the said surface of the bar by a spring to be operated by the uneven surface when the bar is moved. To the lever is secured a tooth, which is adapted to engage the teeth of a wheel in a train of wheels, which is adapted to operate the alarm.

Of General Interest.

METHOD OF HANDLING MATTE.—W. D. KILBOURN, Murray, Utah. The inventor provides a method of handling matte to fracture the same into particles which may be manually handled; provides a method for handling matte buttons whereby the same are fractured into particles readily reduced for treatment; and provides a method of handling the matte buttons which is simple and readily performed.

TRANSMISSION MECHANISM.—P. B. SCHADT and H. E. B. SCHADT, Allentown, Pa. This invention pertains to mechanisms for use in transmitting power developed by prime movers, to the driven members, and has reference more particularly to a transmission mechanism comprising a driving gear member and a driven gear member adapted to mesh together, each of the members being rotatable and movable bodily.

TURPENTINE-SEPARATOR.—D. B. SPHALER and B. F. BRYAN, Taft, Fla. This invention is an improvement in turpentine separators designed for use in separating the turpentine as it is delivered from a still from the water, sediment and other impurities and permit the delivery of the turpentine to a cask or other receptacle freed from the said impurities.

UNIVERSAL CUT-OUT AND SWITCH-BLOCK HOLDER.—E. B. LEMANQUAIS, Bellemead, N. J. In this instance the invention has reference to cutouts and switch block holders, and it has for its object the provision of one which will support the base at a distance from the surface of the cabinet, and which may be used with bases of different forms and size.

FILE-CABINET.—W. A. HARRIS, Greenville, S. C. An object of this inventor is to provide a device which will hold the daily sales-slips, or bills, such as are commonly used in grocery stores, markets, and the like, in such a manner that they may be readily accessible so that the separate account of each customer may be kept without the necessity of the ordinary bookkeeping system.

PIPE-UNION.—C. J. LUTHER, Elizabeth, N. J. This improvement provides a union or coupling device embodying two flanged coupling members having abutting interfitting portions forming a perfect fluid-tight joint, the opposed faces of the flanges having registering tapering recesses for the insertion of a wedge in separating one flange from the other.

HOLDING DEVICE FOR RESETTING SCRAPERS.—J. B. CATHY, Godfrey, Ga. This device may be manufactured at little cost, so that all blacksmiths and farmers may procure at little expense means for shaping and resetting scrapers after they have been sharpened. When sharpened, after they have become dull, they are usually so out of shape that they are of very little value until reset.

CONDENSER.—G. REIMERS, Milltown, N. J. This improvement is in condensers such as are employed in ice and cold storage plants for condensing the hot ammonia gas, the object being to rapidly effect a thorough condensation of the gas by leading the liquid off as fast as formed in the condenser under the action of gravity, thus relieving the condenser of back pressure and giving it a relatively large capacity.

Hardware and Tools.

PIPE-WRENCH.—L. R. BLACKMORE, McKeesport, Pa. The head of the handle is provided with a transverse belt hole, and at opposite sides with projecting studs extending parallel to the axis of the hole. The jaw sections are recessed in their inner faces to fit the head and provided with openings to receive the studs, and with bolt holes registering, when the parts are applied, with bolt hole of the head. Means are provided to receive ends of open links and having notches to receive lateral studs and a chain cooperating with the jaws. Mr. Blackmore has also invented an improvement in chain pipe-wrenches wherein these are the combination of a wrench head having a stem provided with lateral bosses, a chain having connecting links fitting on the bosses, jaw sections fitting at their inner faces over the ends of the bosses and retaining the connecting links therein, and a bolt which secures the jaw sections.

Heating and Lighting.

MINER'S LAMP.—D. MIGLIO, Calumet, Mich. In the present patent the invention is an improvement in miner's lamps, especially designed to strengthen and to reinforce the lamp, and to afford in connection with the reinforcing means the shield or protector which will also act as a reflector.

OIL-BURNER.—A. H. FORSTNER, Portland, Ore. The invention provides a burner wherein is secured a perfect admixture of oil and air; provides a spiral rotary mixture member for controlling the flow of elements to the burner orifice, and provides a removable burner fixture adapted to be removed from the supply pipe and arranged to be disassembled for repair or replacement.

GAS ECONOMIZER AND PURIFIER.—J. W. CARPENTER, Salem, West Virginia. The invention relates to devices for purifying gas and for preventing a wasteful use thereof, and an object is to provide a device which will remove from the gas such impurities as particles of sand, dirt or rust, and to provide means whereby they may be expelled entirely from the device.

Machines and Mechanical Devices.

FEEDER FOR CONCRETE-MIXERS.—F. G. OLP, Nunda, N. Y. The aim in this patent is to provide a feeder, having a plurality of feed worms, which are adapted to convey the different ingredients from the several hoppers to the mixing drum, in predetermined proportions, there being a brush disposed over each of the worms to prevent surplus material from riding therein.

LACE-FEEDING DEVICE.—W. H. JOSLIN and M. H. BENNETT, Scituate, R. I. To overcome the objection of damage to lace and to further automatically test the tips to determine if they are securely applied to the lacing, this lace-feeding device has been devised which is designed to engage the shoulder presented by the rear or inner edge of the tip as formed on the length of lacing from which the lacings are made when the applied blank is severed to form two tips.

Prime Movers and Their Accessories.

APPARATUS FOR PACKING AND UNPACKING STUFFING-BOXES.—A. MEIER and H. DUMELIN, West Hoboken, N. J. The invention provides an apparatus for inserting and removing the packing of stuffing boxes from cylinder heads or from packed recesses; provides an apparatus which may be applied without disturbing the assembled machinery upon which it is to operate, and provides means whereby the hardened or rigid packing may be removed from the stuffing boxes.

ENGINE-GOVERNOR ATTACHMENT.—W. H. GILTNER, Paris, Ky. An object here is to provide means for varying the speed of an engine with relation to that of the governor by which it is normally controlled, so that without changing the speed of the governor, that of the engine may be varied within certain limits. The time of production of the igniting spark may be controlled simultaneously with the varying of the speed of the engine.

Railways and Their Accessories.

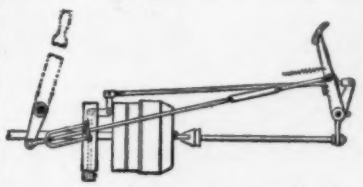
FASTENER FOR RAILWAY-RAILS.—J. M. BLAKE, Meadville, Pa. The invention provides a fastening device quickly and easily adjusted to the rail and tie; provides fastening devices which facilitate the alinement of the rails; provides fastening devices which are readily adjusted to grip the rail and tie, and provides fastening devices adapted to be locked in holding position.

Pertaining to Vehicles.

VEHICLE-HEADLIGHT-STEERING GEAR.—A. G. LINDLEY, Schenectady, N. Y. This invention provides an attachment whereby a lamp is rotated with the steering wheels of the vehicle to cast the light at all times in the path traveled; provides means for revolving the lamps in unison with the movement of the steering wheels around their pivotal mounting; provides means whereby the connected parts of the light steering gear are permitted to work in their joints without jar, and provides means for rotating the lamps laterally and in advance of the rotation of the steering wheels.

SPRINKLER.—J. R. BARNES, New York, N. Y. The aim here is to provide a sprinkler for use on roads, lawns and other places requiring sprinkling with oil, liquid manure or other liquids, the arrangements being such that the barrel containing the liquid can be readily placed in position on the sprinkler and emptied of its contents, and the liquid can be uniformly sprinkled on the desired surface as required.

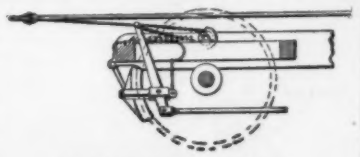
INTERCONNECTED CLUTCH AND BRAKE OPERATING MECHANISM.—S. B. FISHBURNE and I. H. BOND, care the F. B. Company, Columbia, S. C. The construction here illustrated is adapted for the high speed clutches of the transmission used in automobiles of certain types. The object of the invention is to provide for disengaging the



INTERCONNECTED CLUTCH AND BRAKE OPERATING MECHANISM.

high speed clutch of the transmission by the use of the same lever as is employed for applying the engine brake. Heretofore, it has been necessary, when applying the brake, first to disengage the clutch, thus requiring two distinct movements, one of the hand and one of the foot.

AUTOMATIC BRAKE-ADJUSTER.—JOHN S. WASHBURN, Albany, N. Y. The purpose of this invention is to provide means for taking up undue play in the brake mechanism, so that as the brake shoe wears down, the mechanism will adjust itself automatically to compensate for such wear. The brake lever is provided with a tooth that engages a ratchet rack, and



AUTOMATIC BRAKE ADJUSTER.

when the brake rod travels further than normal in applying the shoes, due to wear under the repeated application of the brakes, this tooth passes over to engagement with an adjoining tooth of the rack, leaving the shoes standing from the wheels at the same distance as when they were new.

Designs.

DESIGN FOR A MUFF.—JACOB KARPELES, care of Elektra Toy and Novelty Company, 359 West Broadway, New York, N. Y. In this ornamental design for a muff the front and side presentations represent a long-haired dog with ribbon and bows effectively arranged across the head of the animal.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

TERRY'S MEXICO; A HAND BOOK FOR TRAVELERS. By T. Philip Terry. City of Mexico: Sonora News Company, 1909. Boston: Houghton, Mifflin & Company. 16mo.; 824 pp. Maps, Plans, and Diagrams. Price, $2.50.

At first blush it would almost seem that we were handling a Baedeker's Guide to Mexico, the same format, the same red cloth, the same marbled edge, and the same red and green markers, delight our eye, and if we were to open and find that the similarity went no further, we would indeed be disappointed, for the word Baedeker is certainly the hall mark for guide books. Fortunately we are able to say, after a careful examination of the book, that it is fully as thorough as any of Baedeker's guides, which is great praise. The author considers that the Baedeker form of guide book is the best form to follow, and in this he is wise, and he has followed that model in its physical make-up to a remarkable degree. To say that the book itself is indispensable to the traveler in Mexico does not fall short of the truth. It is remarkable that one man could assemble such an array of facts and figures and withal clothe them with order in the span of an ordinary lifetime. No phase of the subject seems to be omitted; no detail is too small to be looked after. Nearly all of the books on Mexico which purport to be guides, shrink into insignificance when placed in parallel with the present volume. Substance rather than verbiage has been striven for, and notwithstanding the wealth of information, the book is far from being bulky. It is only given to those who have themselves produced guide books to fully appreciate what a good guide book means. It is the most difficult book in the world to compile, and it is open to criticism of all kinds, as a guide book is a book which comes into actual use so that its criticism is comparatively facile to the layman. We do not imagine that there will be very much adverse criticism of this book. It is the best guide book which has come to the reviewer's desk since the SCIENTIFIC AMERICAN Hand Book of Travel.

ELECTRIC WIRING. By Joseph G. Branch, B.S., M.E. Chicago: Branch Publishing Company, 1910. 287 pp.; 93 illustrations. Price, $2.

A most effective form of book teaching a subject, where the student has not the opportunity to discuss the different questions that come up with his instructor, is to put the subject matter in the form of a catechism. We have had electrical catechisms for home study, covering the general field of electrical engineering. This book, however, takes up a more special field, and is adapted to meet the requirements of the wireman, the electrician, or the contractor. The questions are well selected to bring out every phase of the subject, and the answers are plainly expressed. The principal requirements of the National Board of Fire Underwriters are included in the book. There are only a few necessary tables, as it is expected that the reader will prepare his own tables in accordance with his individual requirements.

THE TESLA HIGH-FREQUENCY COIL. Its Construction and Uses. By George F. Haller and Elmer Tiling Cunningham. New York: D. Van Nostrand Company, 1910. 119 pp.; 56 illustrations. Price, $1.25.

The amateur who wishes to experiment with high frequency apparatus will find in this book practical directions deduced from the experiments of the authors. The authors began their experiments with a 7-inch standard coil, which is described in the book. The principal apparatus referred to, however, is a 12-inch coil. Complete directions are given for building the transformer, the condenser, the oscillation transformer, and the interrupter. The theory of the coil is explained in non-mathematical terms, sufficiently to enable the experimenter to understand the work he is performing.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were issued for the Week Ending November 8, 1910,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acid, formic, M. Neumann	975,151
Adding and listing machine, W. Schooling	974,996
Adding and recording machine, G. W. Dudley	975,023
Adding machine, C. Wales	974,937
Aeroplane, inflated, A. E. Maiden	975,263
Agricultural implement, J. P. Baldwin	975,109
Agricultural implement, combination, N. Raez	974,916
Air compressor, J. J. Kiely	975,130
Air compressor, J. & A. H. Hanna	975,233
Air regulator, Shorb & Rodgers	974,997
Airships, car suspension for, Crocco & Ricaldoni	975,390
Alarm. See Water meter alarm.	
Alarm system, W. J. St. Onge	975,175
Animal trap, C. A. Wyman	975,098
Anticreeper, J. Player, Jr.	974,821
Antimony from ores and the like, recovering, J. R. Masson	975,148
Antiskidding device for tires, J. E. Redmond	974,825
Anz-e, earth, W. G. Rogers	975,163
Automobile driving gear, C. C. Bettenhausen	974,771
Automobile driving gear, J. A. Scharf	975,290
Automobile hood, J. P. Gordon	975,128
Automobile radiator, W. Dietz	974,777
Automobile radiator, J. Fleischman	975,343
Automobile runner, T. Milldown	975,267
Autoplane, C. W. Van Winkle	974,846
Axes, hammers, etc., handle extractor for, J. Veno	975,304
Axle for automobile vehicle, shaft-driven, F. Pilain	975,276

Bagasse, treating, T. J. Hutchinson 975,387
Barium hydroxid, making anhydrous, C. Rollin 974,993
Barium oxid, making, C. Rollin 974,921
Barrel cover fastener, H. U. Ruedy 975,080
Barrel, metal, F. E. Firth 975,342
Baths, hammock for douche and similar, G. L. H. Burger 975,016
Beam and truss connection, W. E. Lamb 974,979
Bearing, roller, W. B. Bary 975,201
Bed cover holder, H. K. Dial 975,335
Beet topper and digger, J. J., Jr., & W. A. Devey 975,218
Belt protector, A. A. Ellis 974,780
Belt shifter, B. M. W. Hanson 975,356
Bicycle carrier, C. M. Starr 975,085
Binder, loose leaf, L. F. Scherzinger 974,831
Binder or loose sheet holder, temporary, J. Starkweather & Nottingham 974,999
Board. See Game board.
Boiler cleaner, mechanical, A. C. Clark 975,328
Boilers, means for regulating pressure in steam, J. C. Parker 974,911
Boilers, mold or baffle wall construction for, G. W. Laughton 974,894
Book rest, E. C. Lockwood 975,140
Bottle washer neck cleaning device, W. Penman 975,006
Box, J. H. Carter 975,121
Boxes and the like, corner trimming machine for, H. W. Morgan 974,807
Brake beam, C. F. Huntoon 974,797
Brick kiln, W. T. Hurd 974,969
Brickmaking apparatus, J. P. B. Fiske 974,782
Broom holder, C. H. Sorensen 974,998
Brush, J. B. Rose 974,922
Brush, fountain toilet, Schaefer & Steers 974,994
Bucket, dumping, A. W. French 974,345
Buckling apparatus, E. Bonnin 975,116
Bungs, etc., handle for, R. & A. M. Stock 975,174
Button, cuff, H. R. Kohlweyer 974,976
Calcium carbid, treatment of, C. C. Wakefield 975,306
Calculating machine, F. Trinks 975,180
Calendar, perpetual, S. L. Berry 975,319
Camera, O. W. Plaut 974,999
Can closure, O. Becher 975,317
Car and tool driving machine, track, H. W. Jacobs 975,042
Car and wagon loader, F. L. Simpson 975,297
Car bolster side bearing, C. L. Schwartz 974,832
Car coupling operating attachment, F. Horn 974,795
Car door, C. M. Christenson 975,209
Car door fastener, J. Gauthier 975,347
Car door locking device, C. W. Bitner 975,113
Car step and gate, combination, B. Capra 975,017
Car wheel blanks, manufacturing, H. R. Keithley 975,383
Carbonating machine, L. Caul 974,774
Carbonizing, A. F. Rockwell 975,076
Carbonizing apparatus, A. F. Rockwell 975,077
Carburetor, C. A. Hockman 975,038
Carbureter, H. M. Piepho 975,156
Card-playing device, F. E. Iorio 974,970
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Carrier for compressed fibrous materials, C. H. Merry 974,904
Cash register, E. S. Church 974,962
Cash register, W. H. Gray 975,061
Casting metal, C. H. Upson 974,934
Cement block machine, Baker & Johnson 975,108
Cement block molding machine, R. J. Hamilton 975,231
Chain coupling, J. M. Brown 975,323
Chair, M. B. Williams 975,188
Chart or guide, color, E. W. Fairchild 975,341
Chuck, J. A. Leland 974,896
Churn, T. J. Jarnagin 975,044
Churn apparatus, vacuum, T. Berntson 975,380
Clasp, B. Nelson 975,063
Clasp, S. Zeugschmidt 975,102
Clasp or buckle, Kops & Buchanan 974,977
Clay loader and scraper, W. A. Mohrbach 974,965
Cleaning apparatus, T. J. & D. M. Wilmans 975,095
Closure locking means, C. J. Ljunggren 974,897
Cloth treating apparatus, D. Gessner 975,349
Clutch, friction, J. A. Fridgen 975,226
Clutch, motor cycle friction, J. R. Spangler 974,839
Coat loading device, R. M. Fox 974,225
Coiling device, V. Anderson 975,312
Coating, anticorrosive, F. E. Dodge 975,124
Cock, basin, E. G. Watrous 974,938
Cock, plug, G. Robson 975,162
Collapsible box, F. Pinto 974,820
Color shades, device for finding harmonic, C. Schnebel 974,924
Compressor or the like, rotary, W. von Pittler 974,913
Concrete block making machinery, S. Allen 975,104
Concrete form, adjustable, R. B. Higgins 975,241
Concrete form, adjustable, Higgins & Albers 975,242
Concrete structure, reinforced, White & Ham 975,307
Conduits and tunnels, apparatus for making, J. P. Grohs 974,900
Controlling device, J. E. Radigan 974,961
Convertible chair, M. Shelansky 975,374
Conveyer, W. J. Turnbull 975,181
Conveyer, truck, V. W. Reno 974,918
Cooking utensil, F. O. Rollins 974,828
Copper from ore, extracting, W. L. Austin 975,306
Cork extractor, F. L. Norman 975,384
Corn husker, T. I. Ludwig ..... 975,141 to 975,143
Corn turners, C. J. McCreery 975,242
Crate or box, collapsible, F. E. Sterbett 975,000
Cream, guard for receptacles for whipping, N. M. Doherty 975,336
Cultivator, G. W. Spiers 974,840
Cultivator, C. C. Mehler 975,058
Cultivator fender, W. T. Byrd 975,326
Cultivators, weed cutter for, C. W. Crouse 975,214
Curtain pole coupling, F. E. Stoffregen 975,257
Cuspidor, fountain, J. D. Wilson 975,308
Damper device, H. & C. A. Graves 974,876
Dead lock and latch, combined, P. F. Augenbraun 975,013
Dental floss holder, C. F. Booth 975,205
Dental impression cup, J. H. Gummo 975,033
Dial, memorandum, J. S. McQuinn 974,806
Directory, telephone, W. G. French 974,957
Disk support, C. S. Skinner 975,298
Display stand or case, folding, M. J. Wrenn 975,096
Distillate burning apparatus, C. J. Duff et al. 975,221
Distillation of coal and the recovery of the products, apparatus for the, Richards & Pringle 974,919
Door lock, emergency exit, P. W. Hodgkinson 974,886
Door lock, sliding, F. W. Hettwer 975,037
Door locking device, F. S. Crabtree 975,122
Doors, draft excluder for, G. Gotte 974,959
Double acting, self-feeding drill, R. W. Kreis 974,978
Dredger bucket, C. M. Hickey 975,239
Drill cylinders, front head for, G. S. Power 974,823
Drill feed, W. H. Greene 975,031
Drums, method of and means for supporting rotary, A. B. Helbig 974,964
Dry pan, R. C. Penfield ..... 974,816 to 974,818
Dust collecting and separating apparatus, C. H. Stubley 975,300
Dyeing machine, collapsible revolving beam vacuum, F. M. Morton 975,269
Dyeing machines, ribbed revolving vacuum beam for, F. M. Morton 975,270
Earth drill, J. D. Coplen 975,020
Egg stamp, H. G. Young 975,010
Elbow bending machine, H. C. Walsh 975,184
Electric machines and the like, brush for dynamo, E. O. Schweitzer 974,833
Electrical connector, J. J. Burns 975,118
Electrical coupling and switch, R. H. Wappler 975,090
Electrical heater and manufacturing same in the form of textiles, M. Hefter 975,358
Electrodeposition, producing metallic articles by, F. L. Gibbs 975,386
Electromagnetic waves, receiving apparatus for, E. H. Smythe 974,838
Elevator controller, W. D. Baldwin 974,849
Elevator controlling device, C. Barnum 974,850
Elevator mechanism, J. W. Pogue 974,914
Elevator safety device, C. G. Carpenter 975,018
Engine base, A. E. Shults 975,167
Engine cylinder, H. R. Boggs 974,854
Engine safety stop, sawmill, A. C. Dean 975,216
Engine starting device, J. W. Tudor 974,844
Engine starting mechanism, explosion, S. Jachimovicz 974,972
Engines, manifold for internal combustion, M. B. Rice ..... 9..,992
Engines, method of and apparatus for operating gas, C. White 975,008
Explosive, L. Gray 975,030
Explosive compound, H. Maxim 974,900
Explosive engine, H. C. H. Mustad 974,809
Extensible bracket, H. Noppe 974,273
Eyeglass frame, W. E. Clarke 975,307
Eyeglasses, G. J. Lowres 975,064
Fabric, P. L. Bousquet 974,855
Fastener, J. W. McKitrick 975,266
Fastener, metallic, G. W. McGill 974,805
Fat from effluents, apparatus for removing, R. Schilling 975,081
Faucet, W. L. Heuser 974,790
Faucet, F. Gruschow 974,878
Fender. See Cultivator fender.
Fifth wheel, wagon, W. A. Underhill 975,004
Filaments, making incandescent electric lamp, H. C. Parker 974,812
File cutting machine, J. A. Hess 975,236
Finishing tool, E. Traub 974,932
Fire escape, M. S. Finkelstein 974,781
Fire escape, W. Smith 974,929
Firearm, automatic, K. Krnka 975,256
Firearm magazine, C. H. A. F. L. Ross 975,287
Firearms, greasing device for the ammunition of, R. Frommer 974,784
Fireproof construction, clip and studding for, J. F. Makowski 975,368
Fireproof constructions, filling block for, H. Ericsson 974,868
Flag holder, G. W. Blank 975,114
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Fly paper holder, A. Oisson 975,152
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Flying machines and learning the art of aviation, apparatus for testing, R. Alexander-Katz 975,196
Fodder cutter, J. Dick 974,776
Folding bracket, Richardson & Metzger 975,069, 975,070
Form for garment fitting, model, E. Van Dusen 974,936
Fringe making and embroidering device, H. Gurtler 975,355
Furnace grate, J. C. Merrill 974,902
Furnace heat conductor pipe, C. J. Holub 975,300
Furniture, pneumatic cushion, W. E. Kurtz 975,258
Furniture, store, C. C. Knutter 975,049
Fuse, safety, Leveen & Martin 975,261
Gambrel, G. J. Hauk 974,881
Game apparatus, H. G. Barrett 975,316
Game board, Wright & Powell 975,063
Game counter, E. R. Heusser 975,237
Games, sling for ball, D'Abreu & Seeger 975,193
Garment, W. H. Stevenson 975,087
Garment, combination, L. S. Lee 974,981
Garment holder or rack, A. Johnson 975,246
Garment support, J. R. Randle 975,279
Gas burner, Killgore & Bosworth 975,253
Gas controller, automatic, J. C. Landes 974,980
Gas drip, automatic, O. Justus 974,889
Gas engine, Erickson & Pearson 975,024
Gas feed for vacuum tubes, automatic, D. M. Moore 975,149
Gas filter, G. S. Linn 975,262
Gas generator, acetylene, W. H. Parker 975,154
Gas lighter and extinguisher, automatic, G. Robson 975,160
Gas mains, automatic cut-off for, C. E. Lahmers 975,259
Gas making apparatus, producer, W. O. Ansler 974,945
Gas meter, J. W. Danaher 974,775
Gas scrubber, W. McArthur 975,054
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Glass and cup washing apparatus, U. G. Worrall 974,944
Glove, S. Sachs 975,289
Go-carts, canopy for folding, W. W. Williams 974,942
Golf club, C. Jacobus 974,888
Grading and ditching machine, T. F. Stroud 975,176
Grate shaker engine, W. F. Baker 975,314
Grinding machine, B. M. W. Hanson 975,382
Grinding wheel, etc., L. R. L. Wallen 975,089
Grubber and cultivator, combined grass, C. W. Stark 975,173
Gun, breech loading, J. A. Ricketts 975,071
Hair curler, L. Durbyelle 975,222
Hair singeing device, electrical, Roberts & Johnson 975,073
Hammer, drop, B. & J. Brett 975,206
Harrow, rotary, P. N. Moun 974,808
Harrow tooth holder, J. H. Hoard 975,132
Harvester, cotton, R. L. Edwards 975,125
Harvester or like machine, stripper, S. H. Tyers 975,003
Hat fastener, J. W. Morris 975,000
Hay rake, A. W. Richards 974,827
Hay rake, side delivery, F. L. Lathrop 974,893
Heat insulating linings or coverings, apparatus for manufacturing, A. G. Brown 974,858
Heater, W. J. Dossey 975,022
Heating and ventilating system, combined, L. C. Smith 974,928
Heating body, knitted electric, M. Hefter 975,359
Hinge, J. Wright 975,097
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Hot water heater and circulator, J. Kephart 974,890
Hydrogen gas, electric furnace for producing, Gruter & Pohl 975,129, 975,353
Illuminated announcement and display signal, F. W. Wood 974,943
Insect destroyer, electric, W. M. Frost 974,785
Internal combustion engine, H. F. Bock 974,853
Internal combustion engine, G. M. Periewitz 975,275
Junction box, E. T. Greenfield 975,032
Labeling machine, G. Brand et al. 974,856
Lace fastener, H. F. Levi 975,139
Ladder, metallic, L. Ferguson 975,223
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Lamp body, Nernst, Foeli & Harris 975,126
Lamp burners, globe or chimney holder for, C. W. Caldwell 975,327
Lamp extinguisher, L. Greenwald et al. 975,352
Lamp, flaming arc, R. Scott 975,165
Lamp shades and chimneys, supporting means for, M. Donohoe 975,021
Lamp socket, electric, R. B. Benjamin 974,947
Lamp socket, incandescent, R. B. Benjamin 974,946
Lamps, electric light attachment for gas, J. C. Stearns 974,930
Latch, J. S. Smith 975,361
Lawn sprinkler, H. L. Dietcher 974,954
Leather blanks, apparatus for uniting, J. A. Millican 974,987
Lens grinding apparatus, E. A. Hammett 974,880
Life saving device, J. J. Rectenwald 975,281
Lifting jack, R. J. Northam 974,988
Lightning arrester, W. Butler 974,849
Limb, artificial, A. A. Galvin 975,029
Load binder, R. L. Boyd, reissue 13,164
Locomotive, S. M. Vauclain 975,183
Loom, hand, M. P. & D. Todd 975,179
Loom shuttle, J. La Palme 975,051
Lubricating bearings, means for, W. Holtorp 974,906
Magneto electric generator, G. Honold 974,967
Mail delivering and receiving device, H. G. Eynon 975,025
Mail transferring apparatus, T. R. Cook 975,212
Mandrel, clutch grip, M. Jaeger 975,043
Mangle, W. Leist 975,260
Manure drill, K. Beckmann 975,111
Measuring and recording device, cloth, M. Shalansky 975,373
Measuring apparatus, liquid, D. C. Puderbaugh 974,915
Measuring bin, Carroll & Ricks 975,208
Mechanical agitator, C. S. Batdorf 975,202
Mercerizing, dyeing, or like treatment of loose or woven cotton or other vegetable fiber, machine for, J. H. Robson 975,074
Metal creasing machine, H. C. H. Walsh 975,185
Metallic fabric, making, M. & L. S. Lachman 974,891, 974,892
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Motion transmitting mechanism, reciprocating, D. Roberts 975,283
Mower wheel, lawn, J. H. Auble 974,848
Music leaf turner, G. Regondi 974,826
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Packing, metallic rod, J. Badeker 975,313
Packing or shipping box, J. T. Ferres 974,871
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Paper feeding machine, T. C. Dexter 975,123
Paper hanger's walls, apparatus for removing old, Roberts & Corser 975,284
Paper testing device, H. E. Eddy 974,867
Pen and pencil holder, H. J. Huddle 974,887
Penholder, H. A. Wulff 975,191
Phonautographic record and duplicating the same, E. F. Leeds 974,895
Phonograph diaphragm, P. Weber 975,377
Phonograph reproducer, T. A. Edison 975,340
Photographic meter reader, E. C. Pond, 975,277, 975,278
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Picture frame, F. W. Williams 975,094
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Pipe filling device, tobacco, A. Falk 975,026
Pipe grapple, C. Kass 975,250
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Pipe union, J. T. Kelly 974,975
Piston, E. Talbot 975,301
Piston rod connection, P. M. Van Bosch 974,935
Planter, corn, C. F. Bass 974,851
Planter, wireless check row, S. H. Kline 975,365
Pliers, J. M. Chappel 975,385
Plow, self-propelled, O. Wait 975,305
Plug lifter, H. E. Bennett 975,014
Pneumatic despatch tube apparatus, J. S. Jacques 974,799
Pocket knife, D. W. Bryant 975,015
Polishing machine, A. Thompson 975,088
Pool or like forming device, Kelsey & Monarch 975,135
Pottery former, T. Lunn 975,144
Power, transmission rope, Tolman & Bixby 974,843
Press, K. S. Blanchard 975,204
Printing apparatus, curtain support for blue, R. Herman 974,965
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Propeller for boats, reversible, P. W. Hoigkinson 975,039
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Pump, C. M. Smith 974,837
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Pump, windmill, A. Randolph 975,280
Punch and bolt cutter, R. W. Weatherman 975,006
Quartz mill, J. W. Myer 975,369
Rail bending and straightening device, F. Yoch 975,192
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Rail joint, W. P. & S. G. Thomson 975,376
Rails for the attachment of rail bonds, device for preparing, W. G. Stuart 974,931
Railway pile drivers, etc., turn-table mechanism for, S. G. Knox 975,048
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Railway system, P. Zirou 975,103
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Rake and hoe, combined, A. A. Kohler 975,234
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Resilient connection, J. E. Webster, reissue 13,165
Road machine, M. M. Sickler 975,295
Rod clamp, self-locking, J. Schramm 975,292
Roof climber, T. A. Wilkerson 974,941
Rotary motor, C. De Lukacsevics 974,803
Rubber boot and shoe vulcanizing apparatus, Wren & Comee 975,309
Sample case, J. Glossinger 974,874
Sample holder, Schuch & Tagmeier 975,293
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Sandal, antislipping, H. C. Ashbaugh 975,379
Sander or polishing machine, H. W. Sellner 975,166
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Sawing machine, J. H. Irwin 974,971
School seat, W. B. Cogger 975,019
Screw, P. L. Robertson 975,285
Seal for boxes, S. Whitehall 974,940
Seat cover, sanitary, C. L. Dreher 974,865
Setting, C. Dean 974,862
Sewing machine, W. Pepperling 975,155
Sewing machine table, Kundtz & Schuster 975,050
Sewing machine, two-thread overedge, G. Niedemayr 974,910
Shaft attachment, J. F. Davis 975,332
Shaker, E. K. Hood 974,968
Sharpener, tool, A. Muehlmatt 974,907
Sharpening gravers or other tools, holder for, M. J. Collins 975,329
Shears and scissors, F. Meissner 975,059
Shears for cutting iron, J. Bilesik 975,112
Sheave, safety, W. D. Lockwood 975,052
Sheet feeding machine, R. E. & A. Kemper 975,252
Shellac from stick-lac or the like, obtaining pure, G. J. Fowler 975,224
Shelving, P. A. Lorenz 975,053
Shock absorber, W. A. Johnson 975,249
Shoe polishing foot rest, R. You 974,847
Show window or store front, D. J. 975,150
Side frame, A. H. Weston 975,093
Sight feed, L. M. Fuller 975,127
Sign, advertising, E. N. Heard 975,035
Signal. See Railway signal.
Signal, W. J. O'Brien 974,810
Snap band for molds, C. H. Green 975,351
Snap hook, double-ended, K. Carter 974,950
Snow melting device, C. B. Mann 974,898
Soil stack fitting, W. Goebel 974,875
Solids from liquids, machine for collecting, H. Parker 974,989
Sorting machine, J. W. Pease 975,064
Spark plug, T. C. Luce 974,802
Spark plug, E. C. Rauch 974,824
Spark plug, W. H. McNutt 975,056
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Speed governing mechanism, fluid, J. C. W. Jorgensen 974,973
Spike, pronged, W. T. M. Brady 975,322
Spinning and twisting device, yarn, V. Belanger 975,318
Splice attachment, D. Ambrose 975,199
Spring for flexible connections, J. H. O'Brien 975,274
Spring wheel, M. W. Peck 974,815
Sprinkler, C. A. Borgeson 975,321
Square and protractor, Hennigar & Teneyck 975,036
Square, carpenter's, F. W. Royal 975,079
Square, carpenter's, D. M. Montague 975,268
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Starting device, W. Johnston 975,134
Steam trap, J. J. Harpain 975,357
Steel ingots for rolling, preparing manganese, W. S. Potter 975,370
Steel, production, treating, and rolling of ingots of manganese, W. S. Potter 975,371
Steel strips, apparatus for removing the hardness from certain portions of hardened, H. F. M. Huntsman 975,041
Steel structure, W. A. Dunn 974,779
Steel, treating manganese, W. S. Potter 974,822
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A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since October 4th, 1859, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of June 18th, 1910, or will be sent by mail on request.

(12323) J. W. B. says: Is any given time between 12 and 1 at night to be referred to as A. M. or P. M.? A. The civil day begins at midnight, and ends at the following midnight. The first half of this time is forenoon, and the second half is afternoon. From 12 midnight till 12 noon is A. M., and from 12 noon till 12 midnight is P. M. Any time between 12 and 1 at night is in the morning of the next day. It is ante-meridian. We are writing on Wednesday. At 12 to-night Thursday will begin, and all time after 12 will be Thursday morning. This is the universal mode of expressing dates and time.

(12324) G. B. G. & Co. ask: We desire to place in our building water barrels for extinguishing fire. What solution would be suitable for this purpose, that will not freeze in cold weather? A. The solution generally used for fire barrels is simply a saturated solution of salt in water. If the temperature is likely to fall below zero, calcium chloride may be substituted for salt, as a saturated solution of calcium chloride freezes at a temperature a good many degrees below zero. If your climate is not severe, so that the lowest temperature expected in the room where the fire barrels are placed is not below 20 deg., you could dilute the saturated solution of salt in water by adding an equal quantity of fresh water, thus making a 50 per cent solution, and that will be quite safe against freezing at that temperature.

(12325) J. N. H. asks: Here is a thing that puzzles me very much, and for which I can in no wise account. I wish very much for a scientific explanation, if you have such to offer. This is the phenomena. In this office is an ordinary galvanized-iron water bucket for drinking water. In it rests an ordinary tin dipper. The bowl of the dipper is submerged, and rests as shown in the crude drawing. Everything is quiet in the office, nobody has been using the water perhaps for an hour or two. Nevertheless, every once in a while at long intervals a noise is heard as if the dipper had been afloat, had become filled with water through a leak and had gone to the bottom; also a noise as if the dipper handle had slid around the rim of the bucket a foot or more. The dipper does not leak, and the dipper is invariably submerged by the user. I have never seen what happens, and want to know if you have any knowledge of the cause or theory concerning it. This thing is happening all the time, day and night. A. We think we can suggest an explanation of the curious action of your water pail and dipper. The pail is coated with zinc, the dipper with tin. These two metals will have an electrical action upon each other. The result will be that gas will form from the decomposition of the water in the bucket by electricity near the place where the dipper rests upon the bottom of the bucket. The gas accumulates till it is able to move the dipper and cause the sound. If the bottom of dipper is somewhat hollowed, or concave, so as to prevent the easy escape of the gas as it forms, this would be the result. You can determine if our conjecture is the correct explanation by observing if gas does accumulate under the dipper. The so-called "anti-rust" pail is a galvanized-iron pail with a piece of tin soldered on the bottom of the pail on the inside. The electrical action is sufficient to prevent the water from rusting the iron. You have a similar combination in your pail, and the result may be the same.

(12326) T. W. says: Will 7,000 volts alternating current of electricity kill an ordinary healthy human body? A. It is very improbable that anyone could endure a pressure of 7,000 volts alternating for any length of time. Even 500 volts direct have forced current enough through a person to destroy life. You should observe that the volts do not kill in any case. Amperes kill. Volts furnish the pressure which drives the amperes through the body, and thus destroy life. The pressure used in killing at the prisons is not usually above 1,500 to 2,000 volts alternating.

(12327) R. J. R. asks: What effect does dropping molten cast iron into water have on the metal? Does it chill it the same as putting it into metal molds? A. Any large quantity of molten cast iron dropped into water would cause a generation of steam with almost explosive rapidity. Very small quantities, if dropped in, will separate into shot, and will be extremely hard. You will understand, therefore, that it is impossible to chill large castings by dropping them into water, as the water would be thrown in all directions, and much damage would be done. A metal chill naturally remains in place when the hot iron comes against it, and performs the chilling operation satisfactorily.

(12328) H. E. R. says: Will you kindly inform me through your Notes and Queries column why it is that as the moon advances from the half to the full stage, it does not retain the general crescent form instead of becoming circular? A. The moon passes through all its forms or phases each month. When it is new it is between the earth and the sun, and its dark, unilluminated side is toward us. It is then quite invisible. After a few days it has passed around toward the left far enough for us to see a part of its illuminated side as a slender crescent, or new moon. The bright side is always toward the sun. As it moves on around the earth, it shows more and more of its bright side till it is opposite to the sun, and we see the whole illuminated face. This is full moon. As it moves over the last half of its course, it shows us less of its illuminated face, just as it did on the first half of its course, that is, three days after full it will show about the same amount of illumination as it did three days before full, and so on till it is new again. In Todd's "New Astronomy," page 225, you will find a picture showing how to imitate the phases of the moon, which is very instructive and complete. We can send the book for $1.50, postpaid.

(12329) N. B. says: If a bank 2 feet high is made from the soft ground by digging a trench outside, will it hold water? Should there be a continuous stream of water running to keep pressure under the ice, or can it be kept in shape by renewing the surface with water, or would it dry out and break down? If water is to be kept under the ice, should there be trenches dug under the ice from the supply? A. A soil of heavy clay, when well tamped, should hold water without much leakage. You can tell something of the degree of tightness to expect by noting how long the puddles remain on the clay ground after a shower. Dig your trench on the inside of the proposed dike, throwing the clay outward, and tamp the dike hard. There may be some seepage from the pond, and this can be restored by a small stream of water. With wet ground the leakage may be almost nothing. You will want enough water to flow in under the ice to keep the ice level from settling, and the quantity will depend upon the tightness of the ground under the pond. We suggest trenching on the inside of the dike, i. e., in the pond itself, because that method leaves the dike better supported on the outside, and will reduce the size of the heap necessary to keep the water from breaking through. You can renew the surface by flooding with water if the weather is not so cold that the water will freeze before it spreads evenly over the ice. Another way is to plane or scrape the ice with a steel edge. The pond will hardly freeze solid down to the ground if water is admitted under it from time to time to maintain the level. But if extreme cold weather is likely, and the ground proves practically water-tight, a few narrow and deep trenches radiating from the water inlet pipe will help to spread the water below the ice and keep the ice from freezing to the ground in spots.

(12330) E. B. S. says: Does the size of a boiler have anything to do with the working capacity of the engine if both have the same working pressure? A. You are quite correct. The capacity of the boiler has nothing to do with the working of the engine *provided* it is enough to keep up the working pressure to the desired figure when the engine is running at full load.

(12331) J. G. S. says: Would you kindly give me the rule for figuring the number of cubic feet of gas say in a 100-gallon tank with 25 pounds pressure to the square inch, if reduced to about the same pressure as city gas mains? A. Reduce the capacity of the tank to cubic feet (if given in gallons, divide by 7½) and multiply by the number of atmospheres pressure, an "atmosphere" being equal to 14.7 pounds per square inch. Thus, in your problem, 100 gallons is 13.3 cubic feet; 25 pounds pressure above the atmosphere (as gages read) is 39.7 above vacuum, and $39.7 \div 14.7 = 2.7$ atmospheres; so that the tank contains the equivalent of $13.3 \times 2.7 = 35.9$ cubic feet of free air or gas.

(12332) E. B. says: What is the correct flow of water for power purposes in pipes 16 feet and 10 feet in diameter under a head of 130 feet? A. Generally speaking, if the pipes are only moderately long, a speed of 12 to 18 feet per second would be suitable; if long, say much over 200 feet, the speed should be reduced very much. A 16-foot pipe has an area of 201 square feet, so that the volume passing through it would be 2,400 to 3,600 cubic feet per minute; and the 10-foot pipe would pass two-fifths of the quantity, or 960 to 1,440 cubic feet per minute.

(12333) Mr. Julius M. Wright says: Which is the correct way to run a leather belt—with the hair or flesh side next to the pulley, and why? A. There is some difference of opinion. The hair side of the belt is smoothest and adheres best to the pulley surface, giving greater traction power; while it is also the strongest, and if run next to the pulley eventually wears away, which weakens the belt. Double belts have both sides alike, and as they are always employed for heavy work, the question is not of great importance.

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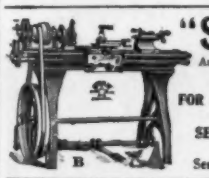

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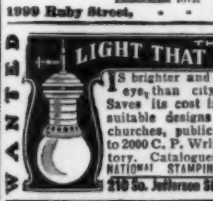

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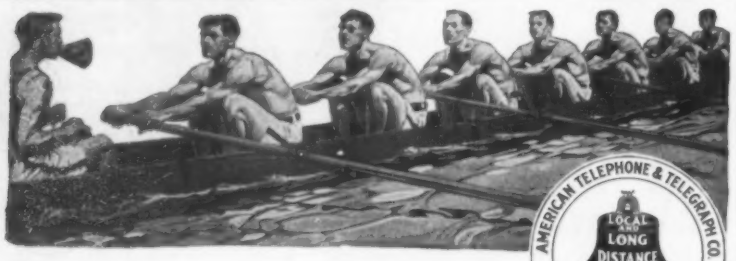

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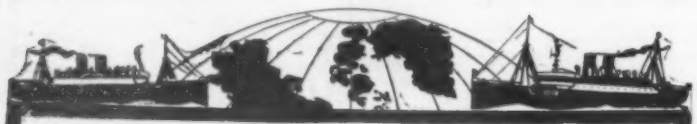

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NEW PROCESSES IN THE MANUFACTURE OF SUPERPHOSPHATES.

(*Continued from page 396.*)

the introduction of the materials, the other for the escape of the vapors, which are cooled and condensed in a tower by means of water spray. This tower holds a charge of from 30 to 50 tons of superphosphate. Beside it is a vertical chute which is separated from the interior of the tower and its contents by a thin but stanch partition. A few hours after mixing, when the superphosphate has set in the form of a pliable mass, more or less porous and moist, the operation of discharging is begun. An instrument resembling a straw cutter with a number of vertical blades, extending over the whole surface of the cake of superphosphate, is employed. During the mixing and forming of the superphosphate, this cutter or scraper is at rest immediately under the top of the tower. Its vertical axis passes through the top and consists of a screw, the length of which is equal to the height of the tower. When this axis is turned by means of a wheel and belt, the scraper descends and rotates, scraping off the upper surface of the cake of superphosphate in thin shavings. By a special contrivance these shavings are carried to the circumference and fall into the chute, the partition between this and the tower having now been removed. Thus as the scraper descends, the superphosphate shavings fall through the chute to the bottom of the apparatus. Here the superphosphate is carried by a bucket chain to an apparatus which will be described later. This operation of discharging occupies about three hours more or less, according to the velocity of rotation of the scraper. When the tower has been emptied, the scraper is again elevated to the top by changing the direction of its rotation. Only one large factory in France is provided with this apparatus.

The Milch apparatus, which I saw in operation at Dantzig in 1908, has a mixing pit in the form of a horizontal cast-iron cylinder which can contain 30 tons of superphosphate. This cylinder is mounted on small wheels, by means of which it can be moved longitudinally. The upper and lower parts of the cylinder are formed of movable plates. After the superphosphate has set, the front end of the cylinder is removed and the cylinder is set into motion by means of two long horizontal screws, which turn in nuts attached to its sides. As it advances, the front surface of the superphosphate is pressed against a scraper similar to that of Overmann, but rotating about a horizontal axis. The bottom plates of the cylinder are removed and the scraper is turned slowly. The superphosphate is shaved off from the cake and falls into a chute under the scraper. At the bottom of the chute the superphosphate is received by a conveyor, which carries it away as fast as it falls. The empty cylinder is then replaced in its former position by turning the screws in the opposite direction.

The apparatus invented in Sweden by Beskow has been rapidly introduced in Germany, where it is already used in several factories and is in process of installation in others. I saw it in operation very recently in a factory at Hanover. The superphosphate mixture falls into a large rectangular wagon, which can contain from 30 to 60 tons. This wagon has a cast-iron bottom with a curved front, and wooden sides. It is provided with a movable cover with water-tight joints, having an opening for the introduction of the superphosphate mixture as it falls from the mixing apparatus immediately above, and is also furnished with a ventilating chimney for the removal of the vapors. The mixing of the charge of 50 tons occupies 2½ hours. After the mass has set, about two hours after the end of the mixing, the top of the wagon is removed and the wagon is drawn backward slowly by a cable attached to a winch at a convenient distance. The backboard and the two sides of the wagon are then removed, exposing the flat cake of superphosphate. As the wagon moves, the cake is pressed against a machine which cuts it into thin slices. This machine has a vertical shaft to which long horizontal arms are attached. Each of these arms carries a vertical scraper. The relation between the rotation of the axis and the advance of the wagon is such that about ¾ inch of the cake is removed at each revolution. When the wagon reaches the end of its course, the part of the cake which is in contact with the semicircular front end is removed to the last grain, because the curve of the front of the wagon exactly fits the curve described by the blades. As the superphosphate is sliced off, it is continually pushed by the lowest blade into a chute at the side of the wagon.

The empty wagon is brought back to the mixing machine by a return cable. The entire apparatus is surmounted by a ventilating hood.

All of these systems appear to operate satisfactorily, but as a former manufacturer of superphosphate, I will permit myself to make a few comparative criticisms.

The Overmann system has three defects: (1) The constant presence in the interior of the tower of a mechanism made of iron, which is rapidly destroyed by the action of the hot and acid vapors. (2) The shavings of superphosphate are pushed horizontally over the cake to its circumference and are thereby more or less compressed and agglomerated. I will explain later the inconvenience of this result. (3) The removal of the superphosphate is commenced with the upper portion, which is of the most recent formation, and finished with the bottom of the mass, which was the first to set. The disadvantage is obvious. The parts first removed are softer than the rest.

The Milch apparatus, although better, is not without defects. The cylinder is made of cast iron and is therefore expensive, very heavy and easily corroded. The steel screws were originally exposed to the action of the acid vapors, but they are now protected by coverings of lead. Finally, the operation of the entire mechanism is heavy and complicated, and there is too much mechanism in contact with corrosive agents.

The Beskow system is free from all of these defects. All the mechanical parts, the wheels, the winch, and scraping machine, are out of doors and not exposed to the action of the vapors. The operation of scraping is easily watched for this reason. The scraper and the wagon are simply and strongly made. Only the bottom of the wagon is of iron and the wooden sides are inexpensive and are easily replaced. For this reason, I should not hesitate to give my preference to the Beskow system.

In all three of these systems the workmen are completely protected from the acid vapors by a ventilating apparatus, which produces a continuous indraught of fresh air and expels the contaminated air through pipes into condensation chambers, where the hydrofluoric acid which they contain is collected, and forms a by-product of considerable value.

An improvement which is not less valuable, although it is older than the machines described above, and which is found in most modern factories, consists in the elimination of the drying process by the introduction of grating machines.

The grating machine is a very simple apparatus, having a vertical shaft of iron, to the lower end of which is keyed a wheel of twelve spokes, each of which has a cutting edge on one side. The machine is mounted on two strong girders so that the shaft rises through a floor and the wheel is immediately below the floor. To the top of the shaft is attached a belt-wheel about five feet in diameter, by which a velocity of from 350 to 400 revolutions per minute is communicated to the shaft and the wheel below. The wheel is thus suspended near the ceiling of a large and high room. One

or more holes 8 inches square are made in the ceiling and the floor above the wheel. The wheel having been set in rotation, the superphosphate, coming from the discharging machine, is allowed to fall upon it through these openings. It is caught by the blades of the wheel, and broken into small particles, which are projected through the air in parabolic curves by the centrifugal force due to the rapid rotation of the wheel. The superphosphate falls in flakes upon the floor of the lower room and there accumulates. In its rapid motion it has not been subjected to any compression and therefore remains porous and pulverulent and ready for either storage or shipment. But this is only part of the advantage secured by the grating machine. In factories equipped with the new apparatus, the superphosphate remains only a few hours in the tower, cylinder, or wagon. The reaction between the sulphuric acid and the neutral phosphate of lime causes a considerable elevation of temperature, and attempts have been made to utilize in drying the superphosphate the heat thus developed. A simple calculation will show the degree of desiccation which can be obtained in this way. The temperature of the reaction attains and often exceeds 212 deg. F. The specific heat of superphosphate is such that in cooling to atmospheric temperature, say 85 deg. F., 100 pounds of the substance loses a quantity of heat sufficient to evaporate 4 pounds of water. It is well known that any substance dries more rapidly when it is in the state of fine particles, which are moving rapidly through the air. These are precisely the conditions that are supplied by the grating machine, which projects the finely divided superphosphate and scatters it through a large, lofty, and well-ventilated room. At the top of this room is an opening, which communicates with a chimney. There is another opening near the floor which communicates with the external air. The result is that a rapid current of air flows upward, while the superphosphate falls slowly downward, so that, although the superphosphate may have a temperature of 195 deg. F. when it meets the wheel, its temperature has fallen to about 90 deg. F. when it reaches the floor. In this flight through the air it usually loses an amount of water equal to 3 per cent of its weight. This partial desiccation is sufficient, because of the porosity of the product obtained by this method. Such a superphosphate, which still contains 15 per cent of water, appears as dry as the product dried by heat, which contains only 10 or 12 per cent of water.

The superphosphate which accumulates in the room is allowed to remain about a day. During this time the sulphate of lime which it contains becomes crystallized by absorbing water. This would ultimately cause a slight hardening of the mass, but the process is interrupted at the end of twenty-four hours by emptying the room by machine and conveying the superphosphate to the general store house. It shows no further tendency to agglomerate, and it may be left stored for months, heaped to a height of 20 feet. It does not retrograde, and remains in the state of powder. These are the chief advantages obtained by the almost universal employment of the grating machine, which has been adopted by more than forty factories in Germany and by nearly fifty in the entire world. The association of the two operations of grating and mechanical removal of the charge from the mixing pits has given wonderful efficiency to the newer factories. It is common to produce sixty tons of superphosphate per day with the employment of three men and a steam engine of 12 horse-power. I do not believe that there is any other industry in which the output is so large in proportion to the labor employed.

In the last factory which I visited the operations are conducted as follows: The ground neutral phosphate is raised by a bucket chain to the top of the building, where it falls into a hopper, which by means of an automatic balance delivers successive charges, as they are required, to the mixing machine immediately below. By the side of this apparatus is one which automatically measures out the charges of sulphuric acid. From the mixing machine, the superphosphate paste falls into the Beskow wagon, which holds fifty tons and is filled in 2½ hours. When the wagon is full, the mixture is allowed to set for two or three hours and is then removed by the method which has already been described. This operation occupies about 1½ hours. As the superphosphate is scraped off the cake in the wagon, it falls through a hole in the floor upon the grating wheel, which scatters it in the chamber or silo below. Here it remains until the following morning. The operations are arranged according to the following schedule: In the morning, from 6 to half-past 8, the three men are occupied in elevating and mixing the raw materials. From 9 o'clock until noon, they are engaged in removing from the silo the superphosphate made the day before and conveying it by wagons or aerial conveyors to the store house. From half-past 1 till 4, they are discharging the Beskow wagon and passing the product through the grating machine. Then the day's work is accomplished, and the remaining two hours, from 4 to 6 can be employed in cleaning and repairing machinery. It is very evident that the work of these men is by no means arduous. They merely tend the machines, and the tool which they most frequently use is an ordinary broom, with which they collect together the particles of superphosphate which have escaped from the automatic machines. Nothing is more striking than the contrast between such a factory, with its absence of odor and dust, and its appearance of room and leisure, and our old superphosphate factories filled with dust, smell, implements, materials, and hard-working men. The most important consideration for the manufacturer is the cost of manufacture, which in France varies from 30 to 50 cents per ton, but is reduced in a modern plant of this kind to 10 cents per ton. The countries which have made the greatest advance in the employment of these new processes are Germany, Austria-Hungary, Sweden, Denmark, and Japan. At present there is a very keen competition among the makers of superphosphate because of the large number of factories. Our manufacturers might act with profit on the German industrial maxim that periods of depression should be occupied in renewing the plant.—Translated for the SCIENTIFIC AMERICAN from La Nature.

WHAT ARE SUN-SPOTS?

(*Continued from page 401.*)

ber of electrically charged particles were set into rapid revolution by the solar vortices, a magnetic field should result. The question for Prof. Hale then to answer became: What warrant was there for assuming the existence of charged particles in the sun, and how could a magnetic field produced by their revolution be detected?

It had been demonstrated by Sir William Crookes in 1879 that, when an electric current was passed through a vacuum tube, a stream of particles would be expelled from its negative pole. That these particles had a real material existence he proved by placing within the tube a light windmill, on whose vanes they impinged and thus set it into rapid rotation. This stream of particles could be deflected by a magnet, and subsequent investigations by Sir Joseph Thomson and others showed that the particles were exceedingly minute and negatively charged with electricity. They were termed "corpuscles" or "electrons," and their mass was estimated at about 1/1700 of the mass of an atom of hydrogen. These minute electrons are not confined to the Crookes tube of the lecture table. If the pressure is sufficiently low, a hot wire or even the glowing filament of an incandescent lamp will give off the corpuscles, and in fact under such condi-

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tions and with high temperatures both carbon and metals will so act whether they are in the form of solids or vapors.

Knowing as we do that the sun is composed of carbon and metallic elements at a high temperature, we are justified then in assuming that great numbers of the corpuscles must be emitted. Furthermore, as it is possible to determine the intensity of current per unit of surface produced by the emission of electrons from a carbon filament at its highest point of incandescence, and as we know that the sun is much hotter, it is reasonable to suppose the existence of more powerful currents in the sun. Therefore it would follow that particles rapidly revolving in these solar vortices were bound to produce magnetic fields. Of this Prof. Hale has produced experimental and positive proof.

In the middle of the nineteenth century (1846) it was discovered by Faraday that if a beam of light which ordinarily consists of vibrations in every direction was polarized or made to vibrate in a single plane, and then was passed through a plate of glass in a strong magnetic field, as between the poles of a powerful electro-magnet, this plane of polarization would be rotated just as is done by a solution of sugar in a polariscope. Indeed, other effects of a magnetic field on light were suspected; but it was not until Zeeman in 1896, when examining with the spectroscope the light of sodium vapor passed between the poles of a strong electro-magnet, noticed a strange effect in the characteristic two lines of sodium which had been found as the result of higher dispersion instead of the single yellow line of the older spectroscopists. When the electro-magnet was excited, the distance between the lines was widened, and when a single line was examined alone, it was found that it was resolved into two components by the magnetic field, the strength of which increased or decreased the interval between the two lines. When the two lines were specially examined, it was found that the light was circularly polarized, or the vibration had a regular but circular movement, which by suitable optical apparatus could be resolved into two beams of plane polarized light.

This investigation was carried on in the physical laboratory, but the modern astrophysicist is quite as ready to avail himself of the work of the physicist as that of the astronomer.

If a sun-spot has been produced by such a vortex as has been described, and if such a vortex acts to produce a magnetic field, then the magnetic field should act on the incandescent vapors, so that the spectral lines due to them should be widened or transformed into doublets, just as happens with the spectrum of the sodium vapor which has been acted upon by the powerful electro-magnet of the laboratory.

Cyrano and the Flying Machine.

(*Continued from page 402.*)

upon his stolen property, but the rockets hissed, and the machine rose in the air, carrying its inventor with it. When the last rocket had burned out, he expected to fall to death, but no such diasaster occurred. The machine slowly sank under him, while he, without effort, found himself rapidly approaching the moon. How is this explained? Very simply, like everything based on superstition. Cyrano had anointed his bruised limbs with beef marrow. The full moon, according to a widely extended belief, exerts such an attraction upon beef marrow that it actually sucks it out of the bones of living animals. The lifting force of the rocket had brought Cyrano so near the full moon that its attraction for the beef marrow exceeded the force of terrestrial gravitation, and thus the traveler was safely brought to his goal. It is uncertain whether Cyrano believed in this attraction of the moon for beef marrow. His sound scientific education makes this improbable. It is more likely that he was attempting to cast ridicule upon a superstitious belief of his time.

Cyrano employs an equally absurd assumption in the machine first described in his works. The sun is supposed to draw the morning dew to itself very rapidly. Hence if a glass vessel filled with dew is attached to a man's person, the sun's attraction for the dew will lift the man from the ground. In order to check the ascent, it is only necessary to break a few of the vessels, and thus diminish the upward force.

Cyrano, in his story, traveled twelve hours toward the sun by this method before he was forced to return to earth by the breaking of some of his dew bottles. He landed, however, not in France, where he had ascended, but in Canada, because during his flight the earth had performed half of a revolution. As the properties of the atmosphere were unknown in Cyrano's time, it is quite probable he believed that such a geographical displacement of the aeronaut would be produced by the earth's rotation.

Finally, Cyrano invented a machine with which he could travel freely through space in any direction, independently of the sun and moon. By appropriate treatment he extracted the attractive power from a large mass of lodestone. The power was then crystallized and compressed into a ball. The inventor places himself on a seat attached to an iron frame and throws the ball of magnetism over his head, thus causing the concentrated crystallized magnetic force to attract the iron frame and lift it until its passenger can grasp the ball. By repeating the process and varying the direction in which the ball is thrown, the flight can be continued indefinitely and in any direction. A trip to the moon was made by this method. On coming near the satellite, it was necessary to check the speed in order to avoid shipwreck on landing. This result was obtained by throwing the magnetic ball a few times backward and sidewise. The machine slowly approached the surface of the moon, and when the aeronaut sprang to the ground, the magnetic ball disappeared in space, drawing the iron frame after it.

With all our progress in physics, chemistry, and the technical arts, we have attained nothing comparable to this exceedingly simple aeronautic device. If we could only impress energy and change the state of aggregation of substances, we might accomplish wonders. This article, however, is not a prophecy, but merely an attempt to show how one educated man foresaw in the seventeenth century the possibilities of development of scientific principles, and how he endeavored to realize the old dream of humanity—the mastery of the air—by technical means. Probably Cyrano did not believe this realization possible, for results which have been achieved in aeronautics would have been thought impossible a few years ago. Cyrano's inventions were regarded by his contemporaries and probably by himself as purely fantastic, and the practicability of some of his ideas has only recently become manifest.

Saving Coal by Burning.

BY GEORGE E. WALSH.

While it is generally admitted that an immense amount of our coal is wasted, or has been in the past, in mining and handling, a greater percentage has been and is wasted in the burning. Now saving coal by burning is the paradoxical slogan of engineers. The loss in mills and factories through improper combustion of coal has been enormous, and the problem of saving this is now being attacked on every side. A factory chimney belching forth clouds of black, sulphurous smoke was formerly considered the sign of prosperity; to-day it is the badge of wastefulness.

How have the factories accomplished the change? First, by a chemical study of the gases and smoke of the flues and chimneys, which showed the amount of waste material, and then by designing grates, dampers, and chimney draft to

control combustion. Second, by utilizing the by-products of the smoke, such as flue dust, which is collected and briquetted for use; heat units, which are carried from the flue to warming chambers, where they preheat boiling water, and by recovering sulphurous acid from the chimney and chemically treating it.

The waste of coal in burning in the ordinary stove and heating plant of our homes is even greater than in the mill or factory. The problem of to-day is to find out how we can in a simple manner save as much of this waste as possible. It is a well-known factor in the industrial world that one plant will use nearly twice as much coal to generate a given horsepower as another. The difference is entirely in the methods of firing and stoking, and in the design of the furnace.

Similarly, in our homes one house will require eight tons of coal to heat it through the winter, and another no larger will take ten, twelve, or even fifteen. Sometimes the houses are just the same, and the furnace designs exact duplicates. Then why the difference? It is in the stoking or firing.

Take an ordinary lamp, and place a chimney on it. If the draft is just right, a bright, illuminating flame will burn without smoking. If the chimney is lifted a little at the bottom, the lamp will immediately smoke. The flame will flare up, and send a tiny wreath of smoke out of the top. Place a piece of tin over the top of the chimney, and the smoking will be increased tenfold. Again, wrap a handkerchief around the base of the chimney so as to close up the draft of the lamp, and we have smoke.

These simple illustrations teach us that imperfect combustion results from either too much or too little oxygen. Waste of heat or light must follow. Now, designers of lamps can make the flame just right for all time, but the designers of stoves and furnaces are not so fortunate. The heat must be regulated and changed. Then too the supply of fuel is not uniform, as in the case of the lamp, and chimney problems must also enter as a factor.

Unnecessarily tall and cold chimneys cause a good deal of waste. These must be heated up before there can be a good draft. Undersized chimneys are likewise bad, for they cannot accommodate sufficient volumes of gases. A chimney must run higher than the tallest part of the house to work well. Outside chimneys are always wasteful coal consumers, because the outside walls are constantly cooling off and retarding combustion. The ideal chimney for drawing is placed in the middle of the house, where it will escape sudden atmospheric changes, and also radiate heat from the bricks into the rooms. Thin chimneys are poor heat conductors and dangerous at the same time. Each fireplace, stove, and furnace should have a separate flue to itself, and this should have as few crooks and angles as possible.

The greater the draft the faster the fuel must be consumed, and the greater must be the percentage of heat units lost through the chimneys. It costs ten times as much in fuel to start a fresh fire as to keep a good one going steadily. It takes nearly as much to stir up a half-dead fire to the heating point. Good firing means that the chimney and flues should not be allowed to get cold. If so, they must be heated up before they can draw well, and this means a great waste of coal.

In mill and factory practice the highest firing results are obtained by keeping a steady, uniform heat throughout the twenty-four hours. This is accomplished either by skillful hand firing or automatic stoking. The latter never permits a great accumulation of ashes. The bed of ashes is kept uniform at all times and the feeding of fresh coals is also uniform. There is no piling of a whole lot of coal in at once, but a little at a time. Good hand stoking follows the same rule.

Now apply this to your home furnace or heater. The old practice of shaking a fire down, removing the ashes, filling up with coal, and turning on all the dampers, is one of the most wasteful imaginable. Slight shaking several times through the day, a few shovels of coal applied every few hours, and with drafts half open, means a uniform, steady fire that will give the greatest amount of heat at a minimum consumption of coal.

It is possible with skillful stoking or firing of this nature to burn soft coal in many of our stoves and furnaces without smudging the landscape with soot and smoke. Get a good bed of hot coals, and then feed gradually and shake lightly. The result is combustion is uniform, and the heat units utilized greater than by any other method. If the chimney draft is good, and the furnace well designed, there should be few occasions when all of the drafts will be needed if skillful stoking is adopted. There will also be a complete reduction of the coal to soft ashes, leaving no half-burnt pieces. Poking will be unnecessary unless clinkers accumulate in places to retard shaking down.

This method of treating the furnace has been tried time and again, with the result of a saving of from two to five tons of coal in the same house in a single winter. The interior temperature of the house was kept more uniform also, because of the more uniform heat maintained in the furnace. Try the method once, and see the difference. The chief thing is always to keep a uniform bed of hot coals in the furnace, and never wait until the fuel is all burnt out before adding new. Shake the furnace down lightly every time fresh coal is put on, and keep the dampers or draft only half or three-quarters open. In very cold weather they may have to be opened full, but not very often or for very long.

Luminous Birds.

Birds with luminous or phosphorescent plumage were mentioned by Pliny and other ancient writers and form the subject of several notes recently published in the Revue française d'Ornithologie. Phosphorescence has been observed most frequently in herons and owls. It has been suggested that the luminosity is due to particles of phosphorescent decaying wood adhering to the feathers. In the case of the heron this hypothesis can hardly be sustained, and the white barn owl, which exhibits the phenomenon of phosphorescence, frequents buildings rather than holes in trees. Besides, the phosphorescence of the feathers is more intense than that of rotten wood. The luminosity of birds' plumage has also been attributed to photo-bacteria living in decomposing animal matter, but this theory appears to fail in the case of a screech-owl which was observed by Spencer and Purdy, in England, to phosphoresce during a period of several months. Luminosity due to putrefaction would vanish on the drying of the feathers.

The most plausible theory is that of Pycraft, who attributes the phosphorescence to a specific fungous growth on the plumage. The greater luminosity of the breast feathers is probably caused by the mechanical and chemical action of the air current encountered during flight; that is, to concussion and excessive oxygenation. This view is supported by the well-known fact that agitation of air or of water containing phosphorescent organisms usually increases the luminosity.

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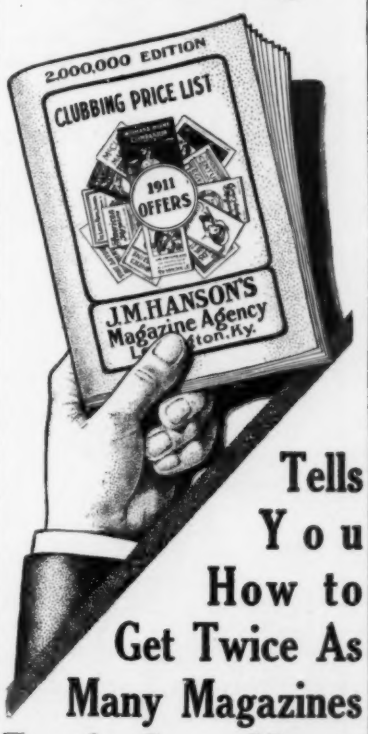

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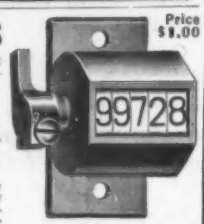

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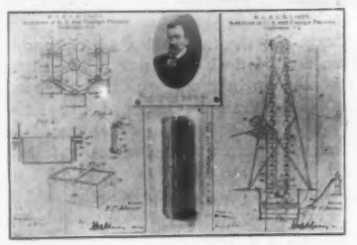

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